CEN/CEN WS SRI

Date: 2024-11-21

Draft CWA XXXXX:2025
(WI=WSSRI001)

Workshop: Standardized On-site SRI Building Audits: Framework Development Workshop

Standardized On-site Smart Readiness Indicator (SRI) Building Audits

Audits sur site standardisés de l'indicateur de potentiel d'intelligence des bâtiments (SRI)

Standardisiertes Smart Readiness Indicator (SRI) Audit (Vor-Ort) für Gebäude

ICS: 27.015, 97.120

(CCMC will prepare and attach the official title page)

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Foreword

This CEN-CENELEC Workshop Agreement (CWA …….:2025) has been developed in accordance with the CEN-CENELEC Guide 29 "CEN and/or CENELEC Workshop Agreements – A rapid way to standardization" and with the relevant provisions of CEN/CENELEC Internal Regulations - Part 2. It was approved by a Workshop of representatives of interested parties on …, the constitution of which was supported by CEN-CENELEC following the public call for participation made on 2024-02-07. However, this CEN-CENELEC Workshop Agreement does not necessarily reflect the views of all stakeholders that might have an interest in its subject matter.

This CEN-CENELEC Workshop Agreement (CWA) is based on the results of the EU-funded project SMART SQUARE (Smart Tools for Smart Buildings: Enhancing the intelligence of buildings in Europe). This project has received funding from the European Union's LIFE-2021-CET-SMARTREADY research and innovation programme under grant agreement No 101077241.

The final text of this CEN-CENELEC Workshop Agreement was submitted to CEN-CENELEC for publication on ….

The following organizations and individuals developed and approved this CEN-CENELEC Workshop Agreement:

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Introduction

The Smart Readiness Indicator (SRI) assesses a building's capability to use information and communication technologies and electronic systems to adapt the operation of buildings to the needs of the occupants and the grid and to improve the energy efficiency and overall performance of buildings. This CEN-CENELEC Workshop Agreement (CWA) addresses the need for a standardized, step-by-step on-site SRI audit procedure. As buildings play a crucial role in energy consumption and environmental sustainability, a clear and consistent audit process is essential. This document provides a comprehensive framework to guide auditors, ensuring reliable and consistent assessments of a building's smart readiness. By establishing these standardized procedures, the CWA supports the development of smart, efficient, and environmentally responsible buildings. The work of this workshop builds upon the findings and extensive research conducted under the Smart Square project, (Smart tools for smart buildings: Enhancing the intelligence of buildings in Europe), funded under the LIFE21-CET-SMARTREADY call of the Environment and Climate Action programme.

Regulation 2020/2156 of the EU provides Member States with the discretion to integrate the smart readiness indicator scheme with their existing energy audit mechanisms. This regulation forms the basis for the workshop's objectives, aiming to establish foundational principles essential for conducting on-site SRI building assessments. The Smart Square project, using this regulation as a foundation, aims to integrate well-established procedures from the EN 16247 energy audit standard to develop a distinctive SRI audit methodology. This effort involves more than just adopting existing procedures; it includes a side-by-side examination of both audit methodologies, an in-depth analysis of the SRI's content, and a thorough understanding of its data recording needs.

The structure of the document is organized to ensure a comprehensive understanding and implementation of the SRI Building Audit Framework. The main sections include the Scope, References, and Terms and Definitions, which set the foundation for understanding the framework. The core of the report covers the SRI Building Audit Framework, Methodology, Documentation and Reporting, and Quality Requirements. Additionally, the document addresses the Competence of SRI Auditors, Implementation and Use, and concludes with Annexes and a Bibliography to provide supporting information and references.

This CEN-CENELEC Workshop Agreement stands as a crucial resource for advancing the field of smart readiness in buildings. It significantly contributes to broader goals of energy efficiency, sustainability, indoor environmental quality and technological integration within the built environment. By setting a foundation for standardizing SRI audits, this agreement supports the creation of buildings that are not only structures but also smart, responsive, and environmentally responsible ecosystems.

1 Scope

This CEN-CENELEC Workshop Agreement (CWA) defines a comprehensive framework for conducting standardized on-site Smart Readiness Indicator (SRI) building audits. The purpose of this document is to establish clear guidelines and methodologies for assessing a building's smart readiness, ensuring that the audit process is consistent, transparent, and reliable. The SRI audit framework outlined in this CWA aims to evaluate the capability of buildings to accommodate smart-ready services, thereby enhancing energy efficiency, occupant comfort, and overall environmental performance.

The scope of this CWA encompasses:

1. Assessment Principles: Establishing the fundamental principles and criteria for conducting SRI audits, ensuring uniformity and consistency across different building types and regions.
2. Audit Methodology: Providing a detailed, step-by-step methodology for performing on-site SRI audits, integrating best practices from existing standards such as EN 16247 and adapting them to the specific requirements of smart readiness assessments.
3. Documentation and Reporting: Outlining the necessary documentation and reporting requirements to ensure that audit findings are comprehensively recorded and communicated, facilitating transparency and accountability.
4. Quality Requirements: Defining the requisites for SRI auditors and procedures for quality assurance and compliance to maintain the integrity and reliability of the SRI audit process.
5. Competence: Establishing the attributes, knowledge and skills for SRI auditors, and outlining the means for their acquisition, maintenance and improvement.
6. Implementation and Use: Providing practical guidance on the implementation and use of SRI audit procedures, including their integration into existing building management practices.

This CWA applies to all stakeholders involved in the planning, execution, and evaluation of SRI building audits, including energy auditors, building owners and managers, regulatory authorities, and technology providers. The framework is designed to be adaptable to various building types, including residential, commercial, and public buildings, ensuring broad applicability and relevance.

By standardizing the SRI audit process, this CWA aims to support the development of smart, energy-efficient, and environmentally responsible buildings. It serves as a critical tool for advancing the integration of smart technologies in the built environment, contributing to the broader goals of sustainability and technological innovation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at http://www.iso.org/obp/

— IEC Electropedia: available at http://www.electropedia.org/

3.1 Smart Readiness and Technologies

3.1.1

Smart Grids

Electrical grids that use information and communication technology to manage electricity efficiently and reliably

3.1.2

Smartness

(of a building or building unit)

Ability of a building or a building unit to sense, interpret, communicate and actively respond in an efficient manner to changing conditions in relation to the operation of technical building systems, the external environment (including energy grids) and the demands from building occupants

3.1.3

Smart Readiness Indicator (SRI)

An indicator that informs on the rating of smart readiness of a building or building unit in line with Article 15(1) of Directive (EU) 2024/1275

The SRI rates the smart readiness of buildings (or building units) in their capability to perform 3 key functionalities:

- optimise energy efficiency and overall in-use performance
- adapt their operation to the needs of the occupant
- adapt to signals from the grid (for example energy flexibility)

3.1.4

Smart-ready Technologies

Technological enabler, such as building automation, for one or more smart-ready services

EXAMPLE Smart meters, building automation and control systems, self-regulating devices for the regulation of indoor air temperature, built-in home appliances, recharging points for electric vehicles, energy storage.

3.1.5

Smart-ready services

A function or an aggregation of functions provided by one or more technical components or systems. A smart-ready service makes use of smart-ready technologies and orchestrates them into higher-level functions

3.1.6

Technical Domains

A collection of smart-ready services which, together, realise an integrated and consistent part of the services expected from the building or building unit

EXAMPLE Heating, cooling, domestic hot water, ventilation, lighting, dynamic building envelope, electricity, electric vehicle charging, monitoring and control.

Note 1 to entry: The term "technical domains" bears similarities with the term "building services" defined in EN ISO 52000-1.

3.1.7

Functionality Levels

The level of smart readiness of a smart-ready service

3.2 Auditing and Reporting

3.2.1

Data Collection

The process of gathering information necessary for conducting an audit, such as as-built building plans, technical specifications and documentation of technical systems and sub-systems, and control diagrams and settings

3.2.2

Documentation Requirements

The specific information and records that must be maintained and submitted as part of the audit process

3.2.3

Energy Audit

Systematic inspection and analysis of energy use and energy consumption of a site, building, system or organization with the objective of identifying energy flows and the potential for energy efficiency improvements and reporting them

3.2.4

Energy Audit Report

A detailed document that presents the findings, analysis, and recommendations from an energy audit

3.2.5

Field Work

On-site activities carried out during an audit, including inspections, measurements, and observations

3.2.6

On-Site SRI Audit

Systematic process of evaluating a building's smart readiness through direct, in-person inspection and data collection

3.2.7

SRI Audit Procedure

Specific steps and processes followed to conduct an SRI audit, including data collection, analysis and reporting

3.3 Building Systems and Performance

3.3.1

Building Automation and Control (BAC)

Products, software and engineering services for automatic controls, monitoring and optimisation, human intervention, and management to achieve energy-efficient, economical, and safe operation of building services equipment

Note 1 to entry: "Control" does not imply that the system or device is restricted to input/output, processing, optimisation, management, and operator functions. Processing of data and information is possible.

Note 2 to entry: Building Automation and Control includes mainly field and control devices, switchgear assembly, cabling, communication and computing devices, system software and functions achieved by engineering services.

3.3.2

Building Automation and Control System (BACS)

System, comprising all products, software and engineering services for automatic controls (including interlocks), monitoring, optimization, for operation, human intervention, and management to achieve energy-efficient, economical, and safe operation of building services.

Note 1 to entry: BACS is also referred as BMS (building management system).

Note 2 to entry: BEMS (building energy management system) is part of a BMS.

Note 3 to entry: BEMS Comprises data collection, logging, alarming, reporting, and analysis of energy usage, etc. The system is designed to reduce the energy consumption, improve the utilisation, increase reliability, and predict performance of the technical building systems, as well as optimise energy usage and reducing its cost.

3.3.3

Control Function

Building automation and control effect of programs and parameters

Note 1 to entry: Building automation and control functions are referred to as control functions, I/O, processing, optimization, management and operator functions. They are listed in the BAC FL (function list) for a specification of work. Building automation and control provide effective control functions for any building energy system, for example, heating, ventilating, cooling, hot water and lighting appliances, that lead to improved operational and energy efficiencies. Complex and integrated energy saving functions and routines can be configured based on the actual use of a building, depending on real user needs, to avoid unnecessary energy use and CO2 emissions.

3.3.4

Fault Detection and Diagnostics (FDD)

Techniques used to identify and diagnose faults in building systems to maintain optimal performance

3.3.5

HVAC Systems

Heating, Ventilation, and Air Conditioning systems used to regulate indoor environmental conditions

3.3.6

Predictive Maintenance

Maintenance activities that are scheduled performed at optimal time based on the predicted condition of equipment, often using data from sensors and monitoring systems

3.3.7

Technical Building Systems (TBS)

Technical equipment of a building or building unit for space heating, space cooling, ventilation, domestic hot water, built-in lighting, building automation and control, on-site renewable energy generation and energy storage, or a combination thereof, including those systems using energy from renewable sources

3.3.8

Energy Performance

Measurable result(s) related to energy efficiency, energy use and energy consumption

3.3.9

Energy Performance Indicator (EnPI)

Measure or unit of energy performance

Note 1 to entry: EnPI(s) can be expressed by using a simple metric, ratio, or a model, depending on the nature of the activities being measured.

3.4 Building Systems and Performance - Heating

3.4.1

Control of Distribution Pumps in Heating Networks

Control mechanisms for distribution pumps in heating networks, including no automatic control, on/off control, multi-stage control, variable speed pump control (internal estimations), and variable speed pump control (external demand signal)

3.4.2

Emission Control for TABS (heating mode)

Control mechanisms for TABS in heating mode, including advanced central automatic control, intermittent operation, and room temperature feedback control

3.4.3

Flexibility and Grid Interaction for Heating

Control methods for heating system interaction with the grid, including no automatic control, scheduled heating system operation, self-learning heating system control, flexible grid-controlled heating system (e.g., DSM), and optimized heating system control based on local predictions and grid signals

3.4.4

Heat Generator Control (all except heat pumps)

Control mechanisms for heat generators, including constant temperature control, variable temperature control based on outdoor temperature, and variable temperature control based on load (e.g., supply water temperature set point)

3.4.5

Heat Generator Control (for heat pumps)

Control mechanisms specific to heat pumps, including On/Off control, multi-stage control based on load or demand, variable control based on load or demand, and variable control based on load and external grid signals

3.4.6
Heat Emission Control

Control methods for heat emission, including no automatic control, central automatic control (e.g., central thermostat), individual room control (e.g., thermostatic valves or electronic controller), individual room control with communication, and individual room control with communication and occupancy detection

3.4.7
Report Information Regarding Heating System Performance

Reporting levels for heating system performance, including none, central or remote reporting of current performance KPIs, central or remote reporting of current and historical performance data, performance evaluation including forecasting and benchmarking, and predictive management with fault detection

3.4.8
Sequencing in Case of Different Heat Generators

Control methods for prioritizing multiple heat generators, including priority control based on running time, fixed priority list (e.g., rated energy efficiency), dynamic priority list based on current energy efficiency, carbon emissions, generator capacity, and dynamic priority list with external grid signals

3.4.9
Storage and Shifting of Thermal Energy

Methods for storing thermal energy, including none, available hot water (HW) storage vessels, and HW storage vessels controlled by external signals (BACS or grid)

3.4.10
Thermal Energy Storage (TES) for Building Heating (excluding TABS)

TES operation methods, including continuous storage operation, time-scheduled storage operation, load prediction-based storage operation, and heat storage with flexible grid control (e.g., DSM)

3.5 Building Systems and Performance - Domestic Hot Water

3.5.1
Control of DHW Storage Charging (with Solar Collector and Supplementary Heat Generation)

Control methods for solar collector and supplementary heat generation, including manual solar or heat generation control, automatic solar storage charge control (Priority 1), supplementary charge, demand-based supply or multi-sensor management, and return temperature control

3.5.2
Control of DHW Storage Charging (with Direct Electric Heating or Integrated Electric Heat Pump)

Control mechanisms for DHW storage charging, including automatic on/off control, scheduled charging, and multi-sensor management

3.5.3
Control of DHW Storage Charging

Methods for controlling DHW storage charging, including none, available HW storage vessels, and automatic charging control based on local renewables or grid info (DR, DSM)

3.5.4

Sequencing in Case of Different DHW Generators

Control methods for prioritizing multiple DHW generators, including running time priorities, fixed priority list (e.g., based on energy efficiency), dynamic priority list based on current energy efficiency, carbon emissions, generator capacity, and dynamic priority list with grid signals

3.5.5

Report Information Regarding Domestic Hot Water Performance

Reporting levels for DHW performance, including none, actual values (e.g., temperatures, energy usage), historical data, performance evaluation with forecasting and benchmarking, and predictive management with fault detection

3.6 Building Systems and Performance - Cooling

3.6.1

Control of Distribution Pumps in Cooling Networks

Control mechanisms for distribution pumps in cooling networks, including no automatic control, on/off control, multi-stage control, variable speed pump control (internal estimation), and variable speed pump control (external demand signal)

3.6.2

Control of Distribution Network Chilled Water Temperature (Supply or Return)

Control mechanisms for chilled water temperature, including constant temperature control, outside temperature compensation control, and demand-based control

3.6.3

Control of Thermal Energy Storage (TES) Operation

Methods for TES operation in cooling, including continuous storage operation, time-scheduled storage operation, load prediction-based storage operation, and grid-controlled cold storage (e.g., DSM)

3.6.4

Cooling Emission Control

Control methods for cooling emission, including no automatic control, central automatic control, individual room control, room control with communication to BACS, and room control with communication and occupancy detection

3.6.5

Emission Control for TABS (Cooling Mode)

Control mechanisms for TABS in cooling mode, including no automatic control, central automatic control, advanced central control, and advanced central control with intermittent operation and room feedback

3.6.6

Flexibility and Grid Interaction for Cooling

Control methods for cooling system interaction with the grid, including no automatic control, scheduled cooling system operation, self-learning cooling system control, cooling system with grid-responsive control (e.g., DSM), and optimized cooling system control based on local predictions and grid signals

3.6.7
Generator Control for Cooling

Control mechanisms for cooling production, including On/Off cooling production control, multi-stage cooling production control based on load or demand, variable cooling production control based on load or demand, and variable cooling production control based on load and grid signals

3.6.8
Interlock for Avoiding Simultaneous Heating and Cooling in the Same Room

Control methods to avoid simultaneous heating and cooling, including no interlock, partial interlock (minimizing risk), and total interlock (prevents simultaneous heating and cooling)

3.6.9
Report Information Regarding Cooling System Performance

Reporting levels for cooling system performance, including none, reporting of current performance KPIs, reporting of current and historical performance data, performance evaluation with forecasting and benchmarking, and predictive management with fault detection

3.6.10
Sequencing of Different Cooling Generators

Control methods for prioritizing multiple cooling generators, including running time priorities, fixed sequencing based on load characteristics, dynamic priorities based on generator efficiency and characteristics, load prediction-based sequencing, and sequencing based on dynamic priority list including grid signals

3.7 Building Systems and Performance - Ventilation

3.7.1
Air Flow or Pressure Control at the Air Handler Level

Control mechanisms for air flow or pressure, including no automatic control (continuous airflow for maximum room load), on/off time control (continuous airflow during nominal occupancy), multi-stage control (reduces fan energy demand), automatic flow/pressure control without reset (load-dependent airflow for all connected rooms), and automatic flow/pressure control with reset (VFD systems)

3.7.2
Free Cooling with Mechanical Ventilation System

Methods for free cooling, including no automatic control, night cooling, airflow modulated to reduce mechanical cooling, and airflow modulation based on temperature and humidity for less mechanical cooling

3.7.3
Heat Recovery Control

Prevention of Overheating: Control methods for heat recovery, including no overheating control, heat recovery modulation/bypass with exhaust sensors, and heat recovery modulation/bypass with room sensors or predictive control

3.7.4

Reporting Information Regarding IAQ

Reporting levels for indoor air quality (IAQ), including none, real-time autonomous IAQ monitoring, real-time and historical IAQ info for occupants, and real-time and historical IAQ info for occupants plus maintenance/occupant warnings

3.7.5

Supply Air Flow Control at the Room Level

Control methods for supply air flow at the room level, including no ventilation system or manual control, clock-based control, occupancy detection control, central demand control based on air quality sensors, and local demand control based on air quality sensors with zone dampers

3.7.6

Supply Air Temperature Control at the Air Handling Unit Level

Control mechanisms for supply air temperature, including no automatic control, constant setpoint with manual adjustment, variable setpoint with outdoor temperature compensation, and variable setpoint with load-dependent compensation

3.8 Building Systems and Performance - Lighting

3.8.1

Control of Artificial Lighting Power Based on Daylight Levels

Control mechanisms for artificial lighting power, including manual (central), manual (per room/zone), automatic switch, automatic dim, and automatic dim with scene-based control

3.8.2

Occupancy Control for Indoor Lighting

Control methods for indoor lighting, including manual on/off switch, manual on/off switch with sweeping signal, automatic detection (auto on/dimmed or auto off), and automatic detection (manual on/dimmed or auto off)

3.9 Building Systems and Performance - Dynamic Building Envelope

3.9.1

Reporting Information Regarding Performance of Dynamic Building Envelope Systems

Reporting levels for dynamic building envelope systems, including none, product position and fault detection, product position, fault detection, and predictive maintenance, product position, fault detection, predictive maintenance, and real-time sensor data (wind, lux, temperature), and product position, fault detection, predictive maintenance, real-time and historical sensor data (wind, lux, temperature)

3.9.2

Window Open/Closed Control, Combined with HVAC System

Control mechanisms for window open/closed status, including manual operation or fixed windows only, open/closed detection for HVAC control, automated window opening based on room sensors, and centralized coordination of operable windows (e.g., for night cooling)

3.9.3

Window Solar Shading Control

Control methods for window solar shading, including no sun shading or manual only, motorized with manual control, motorized with automatic sensor control, combined light/blind/HVAC control, and predictive blind control (based on weather forecast)

3.10 Building Systems and Performance - Electricity

3.10.1

Control of Combined Heat and Power Plant (CHP)

Control mechanisms for CHP plants, including control based on schedule and heat energy demand, control based on RES availability with excess fed to grid, and control based on RES and grid signals with dynamic optimization for self-consumption

3.10.2

Optimizing Self-Consumption of Locally Generated Electricity

Methods for optimizing self-consumption, including none, scheduled electricity consumption (plug loads, white goods, etc.), automated local electricity consumption management based on renewable energy availability, and automated local electricity consumption management based on current and predicted needs and renewable energy availability

3.10.3

Reporting Information Regarding Electricity Consumption

Reporting levels for electricity consumption, including none, building-level electricity consumption reporting, real-time feedback or benchmarking at the building level, real-time feedback or benchmarking at the appliance level, and real-time feedback at appliance level with automated personalized recommendations

3.10.4

Reporting Information Regarding Energy Storage

Reporting levels for energy storage, including none, current SOC data available, actual and historical data, performance evaluation with forecasting and benchmarking, and predictive management with fault detection

3.10.5

Reporting Information Regarding Local Electricity Generation

Reporting levels for local electricity generation, including none, current generation data available, actual and historical data, performance evaluation with forecasting and benchmarking, and predictive management with fault detection

3.10.6

Storage of (Locally Generated) Electricity

Methods for storing locally generated electricity, including none, on-site electricity storage (e.g., electric battery), on-site energy storage with grid-based control, on-site energy storage optimizing local electricity use, and on-site energy storage optimizing local use and grid interaction

3.10.7

Support of (Micro)Grid Operation Modes

Methods for supporting microgrid operation, including none, automated building-level electricity consumption based on grid signals, automated building-level electricity consumption and supply to neighbouring buildings or grid, and automated building-level electricity consumption and supply with potential for limited off-grid operation

3.11 Building Systems and Performance - Electric Vehicle Charging

3.11.1

EV Charging Capacity

Levels of EV charging capacity, including not present, ducting or power plug available, 0-9% parking spaces with recharging points, 10-50% parking spaces with recharging points, and >50% parking spaces with recharging points

3.11.2

EV Charging Grid Balancing

Methods for grid balancing with EV charging, including not present (uncontrolled charging), 1-way controlled charging with optimization, and 2-way controlled charging with optimization

3.11.3

EV Charging Information and Connectivity

Reporting levels for EV charging status, including no information available, reporting EV charging status to occupant, and reporting EV charging status to occupant with driver identification and authorization

3.12 Building Systems and Performance - Monitoring and Control

3.12.1

Central Reporting of TBS Performance and Energy Use

Levels of reporting for TBS performance and energy use, including none, real-time energy use reporting per energy carrier, real-time energy use reporting per energy carrier combining at least 2 domains, and real-time energy use reporting per energy carrier combining all main domains

3.12.2

Detecting Faults of Technical Building Systems and Providing Support to the Diagnosis of These Faults

Levels of fault detection and diagnostics for technical building systems, including no central fault and alarm indication, central fault and alarm indication for at least 2 relevant TBS, central fault and alarm indication for all relevant TBS, and central fault and alarm indication for all relevant TBS including diagnostics

3.12.3

Occupancy Detection

Connected Services: Levels of occupancy detection for connected services, including none, individual function occupancy detection (e.g., lighting), and centralized occupancy detection (e.g., lighting and heating)

3.12.4
Override of DSM Control
Levels of user override for DSM control, including no DSM control, DSM control without user override, manual user override of DSM control, scheduled user override of DSM control, and scheduled override with optimized DSM control

3.12.5
Reporting Information Regarding Demand Side Management Performance and Operation
Levels of reporting for DSM performance, including none, reporting DSM status including energy flow, and reporting historical and predicted DSM status including energy flow

3.12.6
Run Time Management of HVAC Systems
Control methods for HVAC system runtime, including manual setting, scheduled runtime setting for heating and cooling plants, on/off control based on building loads, and on/off control based on predictive control or grid signals

3.12.7
Single Platform for Automated Control & Coordination Between TBS
Levels of platform integration for TBS control, including none, platform for manual control of multiple TBS, platform for automated TBS control and coordination, and platform for automated TBS control, coordination, and energy optimization based on occupancy, weather, and grid signals

3.12.8
Smart Grid Integration
Levels of integration between grid and TBS, including no grid-TBS harmonization (building operates independently), individual TBS demand-side management without coordination, and coordinated demand-side management of multiple TBS

4 Abbreviations

BAC Building Automation and Control

BAC FL Building Automation and Control Function List

BACS Building Automation and Control System

BEMS Building Energy Management System

BIM Building Information Modelling

BMS Building Management System

CHP Combined Heat and Power

COP Coefficient of Performance

CWA CEN-CENELEC Workshop Agreement

DHW Domestic Hot Water

DR Demand Response

DSM Demand Side Management

EnPI Energy Performance Indicator

EPIA Energy Performance Improvement Action

EV	Electric Vehicle
FDD	Fault Detection and Diagnostics
HVAC	Heating, Ventilation, and Air Conditioning
HW	hot water
IAQ	Indoor Air Quality
IEQ	Indoor Environmental Quality
KPI	Key Performance Indicator
LCCA	Life-cycle cost analysis
RES	Renewable Energy Source
SOC	State Of Charge
SRI	Smart Readiness Indicator
SRIA	Smart Readiness Improvement Action
TABS	Thermally Activated Building Systems
TBS	Technical Building Systems
TES	Thermal Energy Storage
UI	User Interface
UX	User Experience
VFD	Variable Frequency Drive

5 Framework for on-site energy and smartness building audits

NOTE For a review of the current regulations and standards, see Annex A.

This section outlines only the necessary steps specific to the SRI assessment, which evaluates a building's potential to integrate smart technologies rather than its energy efficiency. The SRI assessment, distinct from traditional energy audits, focuses on the building's readiness for smart functionality without encompassing energy performance evaluation. The general steps of an energy audit are first presented, followed by a refined approach tailored specifically to smartness assessment.

5.1 Energy audit steps

The energy audit steps, in accordance with EN 16247, are shown in Figure 1.

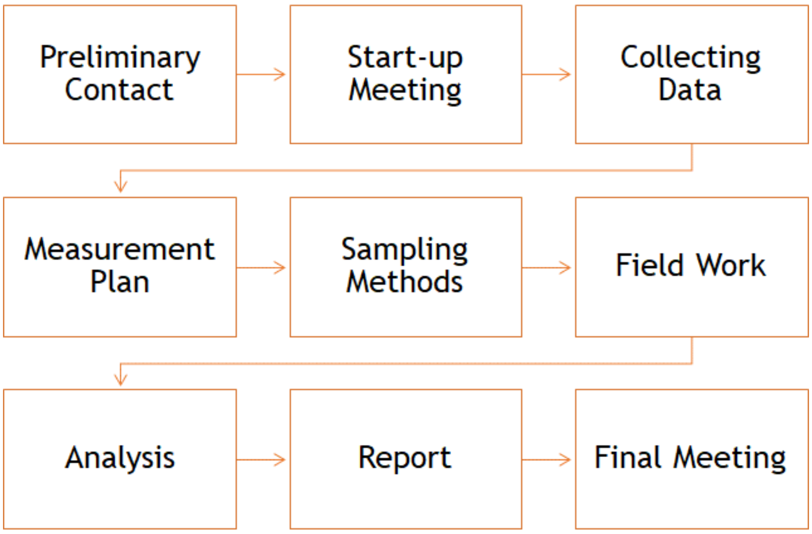


Figure 1 — Energy Audits Steps (EN 16247)

5.1.1 Preliminary contact

The energy auditor must recognize all stakeholders and their roles related to the building's ownership, management, utilization, operation, and maintenance. Their impact on energy usage and interests should be understood. The audit's scope should account for the building's internal system interactions and with the building itself, ensuring a holistic view. The audit's primary objectives might include:

- Lowering energy usage and expenses
- Minimizing environmental impact
- Ensuring indoor environment quality (e.g., comfort, air quality, lighting)
- Meeting legal or voluntary standards.

The audit's scope and boundaries will determine:

- Selection of specific buildings from a list of buildings or parts of a building
- Energy services in focus
- Technical systems inside the building
- External areas and systems
- Which suitable energy performance indicators align with the audit's objectives.

The audit's depth, based on EN 16247-1:2022, needs agreement, considering its effects on time spent onsite, sample selection, modelling, measurements, metering (including sub-metering), identifying energy improvement actions, and the skills the auditor needs.

5.1.2 Start-up meeting

At the start-up meeting, the energy auditor should finalize with the organization:

- scheduling site visits, either during or after working hours
- extent of interaction with occupants

- zones with limited access
- potential health and safety concerns.

The auditor should also gather from the organization, if available:

- indoor environment standards, including temperature, airflow, lighting, air quality, and noise, along with any seasonal changes.
- building's usage patterns based on varying activities.
- feedback from occupants or others about the building's operational efficiency and service quality
- existing energy certificates for the building
- details on any awareness or incentive programs for occupants related to energy.

5.1.3 Collecting data

5.1.3.1 General

Data collection in an energy audit must align with the scale and detail of the audit's objectives. It's imperative that the data gathered provides a comprehensive overview of the energy performance to effectively guide the audit process.

5.1.3.2 Information Request

In collaboration with the organization, the energy auditor's responsibilities include gathering a wide array of essential information. This includes:

- **Current and Potential Energy Sources:** A comprehensive inventory of the current and potential energy sources available for the audited facility.
- **Energy Data:** This includes detailed information about energy flows for each carrier, such as energy pathways for combined heat and power (CHP) systems and distinctions between locally consumed and exported photovoltaic production. Data from existing metering and monitoring tools, including time-stamped readings from devices like heat meters and domestic hot water meters, is crucial. Individual metering data, where available, should also be included, as well as time-specific energy demand trends and any pertinent measurements.
- **Relevant Influencing Factors:** Understanding factors that influence energy use, including climate data, the building's type, occupancy requirements, and occupancy trends, as well as environmental control settings.
- **Changes Over the Past Three Years:** Changes or developments that have occurred over the past three years, or within the relevant data-covered period. This could relate to building structure, alterations in space or usage, changes in the building envelope, modifications to systems and their service areas, tenant changes, and shifts in space usage patterns and settings.
- **Local Performance Indicators:** Metrics aligned with local performance indicators, including floor area, building volume, or any other metrics deemed necessary.
- **Current Design, Operational, and Maintenance Records:** Records and details pertaining to the building's current design, operational characteristics, and maintenance. This encompasses original construction blueprints and any subsequent modifications since the previous audit, external factors

that could impact energy efficiency (e.g., shading from trees or structures), indications of areas receiving heating, cooling, or ventilation services, technical system schematics, control diagrams and settings, and specifications and performance metrics of devices and components.

- **Building Models:** If available, any Building Information Models (BIM) or design models relevant to the facility.
- **In-Building Energy-Consuming Equipment:** Information regarding the equipment within the building that consumes energy.

5.1.3.3 Review of the Available Data

Following the collection of data, the energy auditor should undertake a thorough review of the information gathered. This review should encompass several key actions:

- Assess the data provided by the organization.
- Re-evaluate the scope of the audit.
- Confirm whether the provided data adequately supports the continuation of the audit and aligns with the audit's objectives.
- In cases of incomplete data, define assumptions for missing information, either through data provision by the organization or the auditor's use of well-defined assumptions.
- Leveraging their expertise, select specific energy systems for on-site inspection.

5.1.3.4 Preliminary Data Analysis

With the collected data in hand, the auditor should perform a preliminary analysis to achieve several crucial objectives:

- Gain a deep understanding of the facility's energy balance.
- Identify influential factors that impact energy usage.
- Pinpoint key energy performance indicators that will guide the audit.
- Distribute energy consumption data, where feasible, to comprehend how energy is utilized throughout the facility.
- Identify primary energy uses and their relative contributions to overall consumption.
- Establish an initial energy benchmark against which energy-saving actions can be assessed.
- Determine the need for additional on-site data collection to further refine the audit's insights.

Following this analysis, the auditor will compile an initial list of Energy Performance Improvement Actions (EPIAs) based on their findings and the audit's objectives.

5.1.4 Measurement plan

To ensure the accuracy and effectiveness of on-site data measurement and collection, a collaborative effort between the energy auditor and the organization is essential. This cooperation begins with the establishment of a measurement plan, and the flexibility to revise it based on the auditor's findings during the energy audit is integral to its success.

The measurement plan outlines crucial details regarding the data collection process, serving as a roadmap for the audit. It may encompass various components:

- **Relevant Measurement Points:** Identifying and specifying the locations within the facility where measurements will be taken is a fundamental aspect of the plan. This ensures that data is gathered from points that are critical to the audit's objectives.
- **Associated Processes:** The plan should detail the processes or operations that are connected to the measurement points. Understanding the context in which measurements are taken is vital for accurate data interpretation.
- **Measuring Equipment:** The plan should specify the type of measuring equipment to be used, ensuring that it is suitable for the intended measurements and that it meets the required standards of precision and reliability.

As the energy audit progresses, the energy auditor may recommend adjustments to the measurement plan based on their findings. This adaptability ensures that the data collected aligns with the evolving needs of the audit, ultimately facilitating a more accurate and insightful assessment of energy performance.

5.1.5 Sampling methods

Sampling techniques are employed in energy audits when a comprehensive examination of all available information proves impractical or cost prohibitive. In such instances, it is crucial that the chosen samples accurately represent the entire audited scope. This representation can be achieved by ensuring that the selected samples share certain key characteristics, such as significant energy uses, energy sources and prices, size, process, or vehicle type. For instance, if multiple sites within an organization have similar energy consumption patterns, the auditor may select a sample that encompasses these shared characteristics. The selection of these samples is a collaborative process, and the energy auditor must reach an agreement with the organization regarding which samples to inspect. This mutual understanding ensures that the selected samples are not only representative but also aligned with the audit's objectives. By using sound sampling methods, energy auditors can efficiently gather valuable data and insights while maintaining the audit's feasibility and cost-effectiveness.

5.1.6 Field work

5.1.6.1 Aim of field work

The responsibilities of an energy auditor encompass several essential steps:

- **Examine Target Object(s):** The auditor must thoroughly inspect the specific objects or areas falling within the defined boundaries of the energy audit.
- **Compare On-Site Findings:** It is crucial to compare the observations made during on-site inspections with the data received prior to the audit, ensuring consistency and accuracy.
- **Assess Service Levels:** The auditor should evaluate the current and anticipated service levels for key building services, including factors such as lighting, humidity, and temperature, to ensure that proposed energy-saving actions do not compromise comfort or quality.
- **Evaluate Technical Systems:** The technical systems should be assessed to ensure they meet their intended service levels and operate efficiently.

- **Review System Performance:** This involves a comprehensive review of system performance, considering aspects like control mechanisms, energy storage, and distribution to identify areas for improvement.
- **Recognize Seasonal Patterns:** The auditor must recognize patterns and influences affecting system changes, particularly those driven by seasonal variations and fluctuations.
- **Identify EPIAs and Barriers:** The final crucial step is to identify Energy Performance Improvement Actions (EPIAs) while also acknowledging any potential barriers or obstacles that may hinder the implementation of these actions. This step sets the stage for making informed recommendations for energy efficiency enhancements.

5.1.6.2 Conduct

The energy auditor's responsibilities encompass two key elements:

- **Ensure Accurate Measurements and Observations:** It is imperative that all measurements and observations accurately reflect standard operations. This includes assessing conditions during non-standard hours, maintenance periods, or when no expected weather impact is present.
- **Promptly Report Unforeseen Challenges:** Any unexpected challenges or issues encountered during the audit must be promptly communicated to the organization to facilitate efficient problem-solving and decision-making.

5.1.6.3 On-site Visits

In the process of selecting sample locations for inspection, the energy auditor will personally visit each designated site. The organization will be requested to:

- **Appoint Knowledgeable Guides:** The organization should designate one or more individuals with the requisite expertise and authority to assist and accompany the auditor throughout the inspection. These guides may also be responsible for managing equipment and overseeing processes.
- **Provide Essential Documentation:** Critical documents, such as blueprints, manuals, operational data, and commissioning test results related to the facility, should be supplied to the auditor to aid in the comprehensive assessment.

Additionally, the auditor should make the following requests to the organization:

- Access to Electronic Data Sources: Read-only access to electronic data sources and Building Automation/Control Systems (BACS) is vital to obtain real-time information and monitor energy-related data.
- Facilitate Tests and Operations: The organization should enable the execution of tests and operations as needed, which might involve toggling systems or accessing electrical areas to gain a more profound understanding of energy consumption and efficiency.
- Provide Access to Crucial Building Sections: To conduct a thorough energy audit, the auditor should be granted access to specific building sections that are pivotal for the assessment. This access is essential to gather essential data and insights to inform the audit process.

5.1.7 Analysis

5.1.7.1 General

During a building's energy audit, auditors are tasked with identifying energy-saving potentials while adhering to the audit's specific objectives. To achieve this, the following considerations are paramount:

- **Comparing Current vs. Optimal Service Levels:** Auditors must ensure that any proposed Energy Performance Improvement Actions (EPIAs) do not compromise the quality of service within the building, including critical factors like indoor climate comfort and air quality.
- **Assessing Technical System Performance:** The auditor should measure the performance of technical systems against established benchmarks, assessing their efficiency and effectiveness.
- **Analysing Building Envelope Efficiency:** This involves a thorough evaluation of insulation and air tightness, addressing key components of a building's energy efficiency.
- **Evaluating Holistic Building Energy Performance:** Auditors should analyze the interplay between various systems and the building envelope, recognizing that energy efficiency improvements may involve complex interactions between these elements.

For EPIA considerations, auditors must:

- **Understand System Interactions:** Auditors should have a comprehensive understanding of how technical systems, the building envelope, external conditions, and internal activities influence energy consumption and efficiency.
- **Assess Energy Impacts Across Conditions:** It's vital to gauge how proposed energy-saving measures perform under different conditions and throughout different seasons.
- **Evaluate Environmental Performance:** Auditors must determine how these energy-saving measures affect not only energy performance but also environmental performance ratings, considering emissions and sustainability.

The audit should also include a thorough examination of energy supply contracts and maintenance protocols to assess their efficiency and cost implications.

5.1.7.2 Energy Breakdown

The auditor is responsible for providing a comprehensive breakdown of the building's energy consumption, cost, and emissions by type. This breakdown should be presented clearly and transparently, differentiating between measured and estimated energy flows. Furthermore, the auditor should outline energy usage by service in consistent units and include any relevant information on onsite energy production and third-party exports.

5.1.7.3 Energy Performance Indicators (EnPI)

Incorporating energy performance indicators (EnPIs) into the analysis is vital for understanding and communicating energy efficiency. The auditor, in collaboration with the organization, must agree on the specific metrics and indicators to be utilized in the audit. These indicators may include specific energy usage, energy intensity, and other relevant measures that align with the audit's goals and industry standards.

5.1.7.4 Energy Performance Improvement Actions (EPIA)

The auditor should propose Energy Performance Improvement Actions based on a combination of factors:

- **Expertise:** Drawing on their knowledge and experience, auditors should recommend actions that align with best practices and industry standards.
- **Relevant Benchmarks:** Auditors should consider established benchmarks and targets when proposing EPIAs, ensuring that the actions are in line with industry norms.
- **Building Age and History:** The building's age, maintenance history, and existing system operations should be considered when proposing improvements, as older buildings may require different approaches than newer ones.
- **Technology Quality:** Evaluating technology quality relative to cutting-edge standards is crucial for proposing actions that leverage the latest advancements in energy efficiency.
- **Best Practices:** Recognized best practices should guide the selection of EPIAs, ensuring that the recommendations are in line with proven strategies for energy savings and sustainability.

5.1.8 Report

The energy audit report must cater to a diverse audience, including both technical experts and management personnel. To facilitate effective decision-making, the proposed energy-saving interventions should be thoughtfully categorized into the following sections:

- **High-Cost Actions:** This section should encompass significant investments, such as infrastructure updates or capital-intensive projects, which may require substantial financial commitment.
- **Low-Cost Solutions:** Here, the report should outline operational adjustments or relatively inexpensive measures that can result in energy savings.
- **End-User Education and Motivation:** This segment is dedicated to strategies involving training, motivation, and behavioural change initiatives aimed at encouraging energy-conscious practices among users.
- **Comfort, Health, and Well-Being Considerations:** In this category, the report should address factors related to climate settings, indoor air quality, and occupant comfort.

The energy audit report must be structured to provide a comprehensive understanding of the audit findings and recommendations. To achieve this, the document should include the following essential components:

- **Executive Summary:** This section offers a concise overview of the report, highlighting key findings and recommendations for quick reference.
- **EPIA Opportunities:** The report should identify and elaborate on Energy Performance Improvement Areas (EPIAs) where potential energy-saving interventions can be implemented. This section outlines the opportunities for energy efficiency improvements.
- **Energy Audit:** A detailed analysis of the current energy usage patterns, infrastructure, systems, and operations within the audited facility. This section provides the foundation for understanding the energy performance and potential areas for improvement.

- **EPIA:** Building on the identified EPIAs, this section delves into specific recommendations for energy-saving interventions. It outlines the proposed actions, including their feasibility, costs, and expected energy savings.
- **Conclusions:** This segment summarizes the key takeaways from the energy audit, emphasizing the most critical findings and the overall potential for energy efficiency enhancements.

Incorporating these elements into the energy audit report ensures that it serves as a valuable tool for informed decision-making, catering to the technical and managerial aspects of the organization's energy management strategy.

5.1.9 Final meeting

After the concluding meeting, the energy auditor is tasked with several critical responsibilities. Firstly, they must promptly deliver the energy audit report, providing a comprehensive overview of the audit findings, insights, and recommendations. This report serves as a crucial document to guide the organization's energy-related decisions. Secondly, effective communication of the findings is essential. The auditor should present the results in a clear and understandable manner, tailored to the organization's specific needs and goals. This ensures that decision-makers can grasp the implications and act upon the recommendations. Thirdly, the energy auditor should be prepared to address any queries or uncertainties raised by the organization regarding the audit results. Clarification of the findings is crucial to foster a deep understanding and trust in the audit process. After these steps, the organization will engage in discussions to deliberate on the subsequent actions and requirements proposed in the energy audit report. This collaborative decision-making process enables the organization to implement energy efficiency improvements effectively, reducing costs and environmental impact.

5.2 Defining SRI On-Site Audit Steps Based on Energy Audit Methodologies

In order to deliver the SRI On-Site Audit effectively, a comparative analysis between the traditional energy audit and the SRI assessment was conducted. This assessment aimed to identify and filter out elements that are not essential for the SRI audit while incorporating those that are crucial for evaluating a building's smart readiness. The goal was to streamline the SRI audit process, ensuring it is both comprehensive and focused on relevant aspects of smart building services. This section provides a detailed overview of this comparative assessment, highlighting the key differences and similarities between the two methodologies. By understanding these distinctions, auditors can ensure a more accurate and efficient SRI assessment, aligning with the specific requirements and objectives of the SRI framework.

Table 1 delineates a comprehensive comparison between the nine structured steps of the energy audit procedure and their corresponding elements within the SRI methodology, further highlighting which steps are retained for the SRI method. Figure 2 offers a succinct overview, summarizing the alignment of these steps.

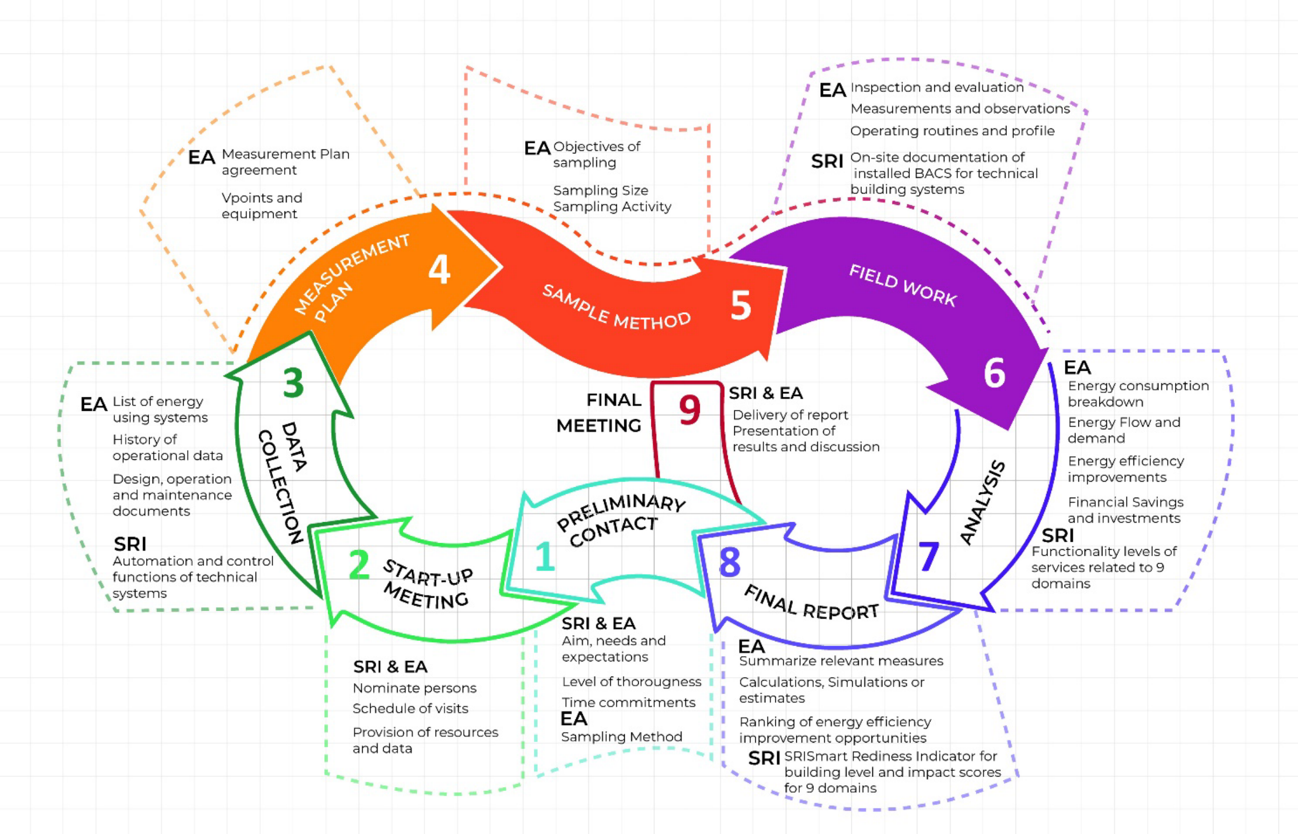


Figure 2 — Nine-step procedure of energy audits vs SRI audit

The comparative analysis between the EN 16247 energy audit procedures and the Smart Readiness Indicator (SRI) highlights distinct methodological differences. Notably, the **SRI omits direct measurements and sampling**, focusing instead on the building's potential to utilise smart technologies and operations. The traditional energy audit, rooted in the EN 16247 standard, offers a granular, hands-on approach, emphasizing immediate inefficiencies and rectifications.

Table 1 — Detailed Alignment of EN 16247 Audit Steps with SRI Methodology

Steps	Energy Audit	SRI	Retained for SRI Method
Preliminary Contact	▪ Establishing the primary aims and objectives ▪ Understanding building-specific needs ▪ Deciding the Level of thoroughness ▪ Time and resources allocation ▪ Agreeing on the Sampling method	▪ Clarifying the intent and objectives of SRI evaluation ▪ Recognizing building-specific adaptation requirements ▪ Defining the depth of SRI analysis ▪ Time and resources forecast	Yes
Start-up Meeting	▪ Nominating main contacts and stakeholders ▪ Planning site visits ▪ Organizing resources and data provision	▪ Identifying main SRI contacts and coordinators ▪ Coordinating specific site visits ▪ Arranging related resources and data	Yes

Steps	Energy Audit	SRI	Retained for SRI Method
Data Collection	▪ Comprehensive list of energy systems ▪ Historical operational and consumption data ▪ Design, operation, and maintenance documentation	▪ Gathering information on automation and control functions	Yes
Measurement Plan	▪ Confirming the measurement plan ▪ Establishing measurement points and required equipment	▪ Not directly applicable in SRI	No
Sample Method	▪ Defining sampling objectives ▪ Determining sampling size and frequency ▪ Finalizing sampling activities	▪ Not directly applicable in SRI	No
Field Work	▪ On-site inspections and system evaluations ▪ Recording measurements and observations ▪ Understanding operational routines and profiles	▪ On-site inspections available smart functionality levels of various TBSs ▪ Understanding operational routines	Yes
Analysis	▪ Breaking down energy consumption ▪ Evaluating energy flow and demand ▪ Pinpointing potential energy efficiency improvements ▪ Estimating financial implications	▪ Analysing the functionality levels of various building services align with the nine designated technical domains of SRI	Yes
Final Report	▪ Summarizing key measurements and findings ▪ Detailed calculations, simulations, or estimates ▪ Prioritizing energy efficiency improvement strategies	▪ Computing the Smart Readiness Indicator at building level ▪ Generating smart-readiness scores across the nine technical domains, impact criterion and key functionality highlighting areas of improvement	Yes
Final Meeting	▪ Presenting the energy audit report ▪ Discussing results, findings, and recommendations	▪ Sharing the SRI evaluation report ▪ Discussing the smart readiness rating and potential enhancements	Yes

6 Framework for On-Site SRI Building Audits

6.1 Principles for Conducting On-Site SRI Audits

The principles for conducting on-site Smart Readiness Indicator (SRI) audits generally involve a systematic approach to evaluating a building's readiness for smart technologies. Here are some overarching principles commonly considered in on-site SRI audits:

- **Comprehensive Assessment:** Perform a thorough examination of the building's technical systems, linked to the services across the technical domains.
- **Data Collection:** Gather detailed data on the existing technical infrastructure, particularly on the automation and control functions.
- **Interconnected Systems:** Assess how different technical building systems (TBS) are interconnected and communicate with each other.
- **Functionality Levels:** Determine the functionality levels of each service, evaluating their current smart capabilities and potential for improvement.
- **Smart Technology Integration:** Identify the presence and integration of smart technologies within the building, including sensors, controllers, and automation systems.
- **Occupant Interaction:** Evaluate the level of interaction and control that building occupants have over smart systems, considering user interfaces and accessibility.
- **Energy Efficiency:** Assess the energy efficiency of the building and the impact of smart technologies on energy consumption.
- **Grid Interaction:** Examine the building's ability to interact with the electrical grid, considering demand response capabilities and integration with renewable energy sources.
- **Data Privacy and Security:** Ensure that the implementation of smart technologies adheres to data privacy and security standards.
- **Scalability and Upgradability:** Evaluate the scalability and upgradability of the existing systems to accommodate future advancements in smart technologies.
- **Regulatory Compliance:** Verify compliance with relevant regulations and standards related to smart building technologies.
- **Stakeholder Engagement:** Involve key stakeholders, including building owners, facility managers, and occupants, in the assessment process to gather diverse perspectives.

These principles guide the audit process, helping to create a comprehensive understanding of a building's smart readiness and identifying areas for improvement.

6.2 Data Recording and Analysis Requirements

The data collection and analysis requirements for an on-site SRI audit ensure a thorough and systematic approach to evaluating a building's smart readiness. This section outlines the essential data elements that need to be captured, along with the methodologies for analysing these data points to provide a comprehensive assessment. Note that some required data may be available from existing audits and building information and may not need to be collected during the SRI audit.

6.2.1 Building Information

- Size: Document the total useful floor area (m^2) and volume (m^3).
- Usage: Record the primary and secondary functions of the building, including any specific operational patterns.
- Age: Note the year of construction and major renovations or retrofits. Identify and describe the alterations from the original building status.
- Location: Capture geographical coordinates, climate zone, and relevant environmental factors.
- Building State: Indicate whether the building is in its original state or has been renovated.

6.2.2 Technical Building Systems (TBS)

- Heating System: Document the types and specifications of heat generators, thermal energy storage, and control mechanisms. Assess functionality levels based on temperature control, load control, and grid interaction.
- Cooling System: Record details about chillers, thermal energy storage, and control systems. Evaluate control strategies and grid interaction capabilities.
- Ventilation System: Capture data on heat recovery systems, air handling units, and control methods. Assess the efficiency and responsiveness of these systems.
- Lighting System: Document types of lighting controls, including occupancy detection and daylight integration.
- Dynamic Building Envelope: Record details about window controls, shading devices, and their integration with HVAC systems.

6.2.3 Grid Interaction and Flexibility

- Energy Storage: Document any thermal or electrical energy storage systems, including their capacity and control methods.
- Renewable Energy Integration: Record data on any on-site renewable energy sources (e.g., solar, wind) and their integration with building systems.
- Demand-Side Management (DSM): Capture information about DSM strategies and their effectiveness in optimizing energy consumption.

6.2.4 Performance Data

- Energy Consumption Patterns: Collect historical energy usage data, including electricity, heating, and cooling consumption. Analyse trends and peak usage periods.
- System Performance: Record performance metrics for HVAC, lighting, and other TBS. Include current and historical performance data, where available.
- Occupant Interaction: Document user interfaces and control systems available to occupants, assessing ease of use and functionality.

6.2.5 Reporting and Compliance

- Report Information: Ensure all data collected is accurately reported, following standardized formats for clarity and consistency. Include performance evaluations, benchmarking, and predictive management data.
- Regulatory Compliance: Verify that all recorded data and analysis comply with relevant regulations and standards.

6.2.6 Data Analysis

- Functionality Levels: Assess the existing functionality levels of each TBS to determine their current state and potential for improvement.
- Comparative Analysis: Compare current performance data with historical data and benchmarks to identify trends, inefficiencies, and opportunities for improvement.
- By adhering to these data recording and analysis requirements, the SRI on-site audit ensures a comprehensive and accurate evaluation of a building's smart readiness. This systematic approach helps in identifying areas for enhancement, thereby supporting the development of smarter, more efficient buildings.

6.3 Step-by-Step SRI On-Site Audit Procedure

The detailed SRI On-Site Audit procedure consists of six critical steps, which are delineated below:

6.3.1 Preliminary contact

The first step is all about setting the stage for the audit. Here, the primary objectives, specific requirements, and expectations for the SRI audit are established. This is a crucial step as it defines the depth or level of thoroughness the audit will delve into. It's also where all parties agree on the timeframe for the audit, ensuring everyone is aligned in terms of scheduling and commitments.

6.3.2 Start-up meeting

Once the preliminary groundwork is laid, a start-up meeting is convened. This is where key personnel who will be involved in the audit are nominated. It ensures that there are designated individuals responsible for different facets of the audit, ensuring smooth execution. The schedule for site visits is finalized in this step, ensuring that all required locations are accessible for assessment. Moreover, there is a clear discussion about the necessary resources and data that will be required during the audit, ensuring everything is in place before the actual evaluation begins.

6.3.3 Data collection

Armed with a clear plan, the next step revolves around gathering data, particularly focusing on the documentation of automation and control functions of technical systems. Understanding how these systems operate and their current configurations is crucial to evaluate the building's smart readiness capabilities.

The primary sources of information for gathering data on the automation and control functions of technical systems include system documentation, operation and maintenance manuals, and building management system (BMS) reports. These documents typically provide detailed descriptions of the system's design, configuration, and operational parameters. Additionally, site inspections and interviews with facility managers and maintenance staff can offer valuable insights into the practical aspects of system functionality, including any deviations from documented configurations and any informal practices that may affect system performance.

6.3.4 Field Work

The smartness auditor needs documents and drawings of the building, its technical systems and automation, control and management functions for the audit work. The smartness auditor shall carry inspect the assessed object within the scope and boundaries of the audit against the data received. The auditor should be aware that even if documents are available, they may not contain the correct information/latest updates and therefore all essential information should be checked during site visit.

The smartness auditor shall perform a triage process by which the applicability of the technical domains and services included in the assessments is determined. This is performed by means of an analysis of the installed technical building (sub-)systems. Systems are audited according to their existence and functions implemented whereas non existing equipment does not need to be mentioned. Logic shall identify non-existing equipment and exclude it from the evaluation. Next, the BAC and TBM functions should be inspected with a view to determining the functionality levels of the applicable smart-ready services. Clear and structured records of the proof of applicability of technical domains, smart-ready services, and functionality levels should be kept during the site visit.

The auditor shall also understand the logic and operational routines of building automation, control, and management functions. Also, the drivers for the changes in energy performance and operation, response to user needs and energy flexibility of the assessed object. In addition, restrictions and constraints for smartness improvements should be looked for.

A checklist template is provided in Annex B.

6.3.5 Analysis

The collected data is then subjected to comprehensive analysis, with a primary emphasis on identifying the functionality levels of various services within the building. Initially, the technical building systems present in the assessed object need to be identified. If present, their functionality levels must be determined, considering the nine established domains of SRI. The objective is to assess how each service aligns with the desired functionality level across these nine domains.

6.3.6 Final report

Following the analysis, a comprehensive report is compiled, yielding a definitive Smart Readiness Indicator at the building level. Moreover, it presents impact scores for each of the nine domains, offering stakeholders a precise assessment of the building's standing in terms of smart readiness. The report further delineates opportunities for enhancing it should be aimed at enhancing the smartness to achieve better building performance e.g. thermal comfort.

6.3.7 Final meeting

To round off the audit process, a final meeting is organized. Here, the SRI evaluation report is presented to all relevant stakeholders. It's an interactive session where the building's smart readiness level is discussed in detail.

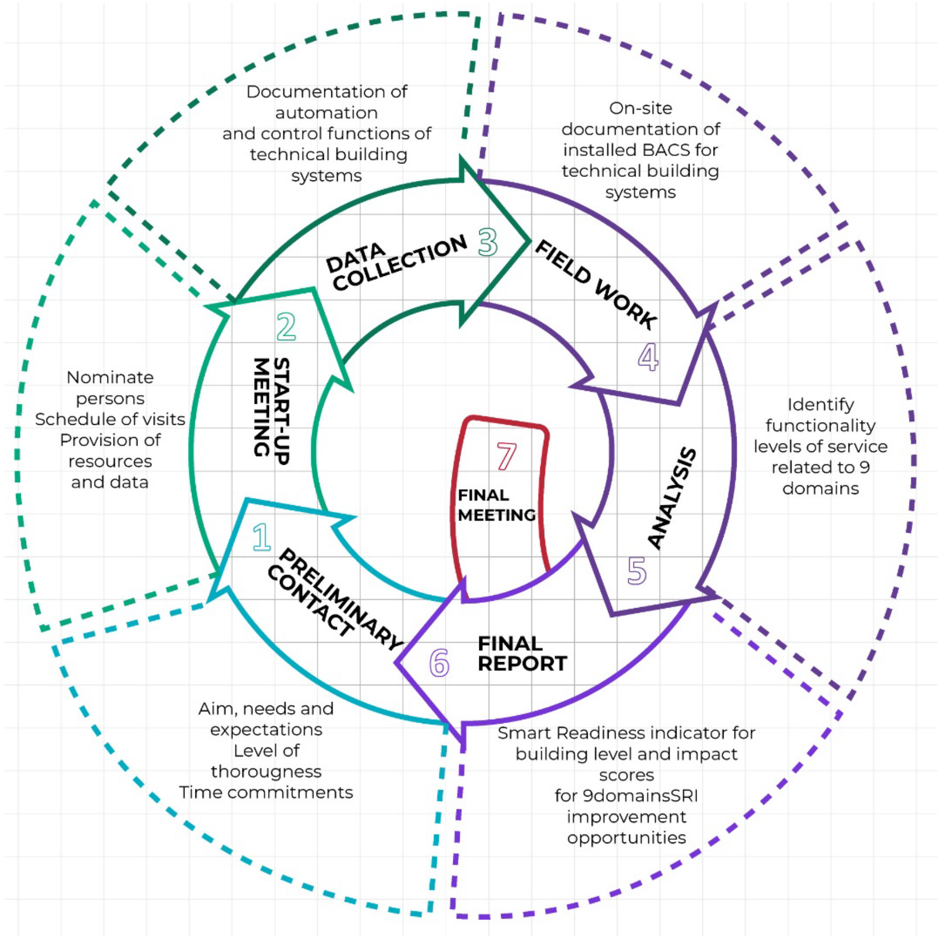


Figure 3 — Framework of SRI Audit

This is also the platform where potential improvements are deliberated upon, ensuring all parties are aligned on the next steps and future strategies to elevate the building's smart readiness.

Through this methodical approach, the SRI On-Site Audit procedure ensures that buildings are thoroughly evaluated, and stakeholders are equipped with actionable insights to make informed decisions about enhancing their building's integration with smart technologies. Figure 3 provides a comprehensive overview of the steps involved in the SRI Audit process. Figure 4 illustrates the steps involved in the procedure for implementing an SRI Audit.

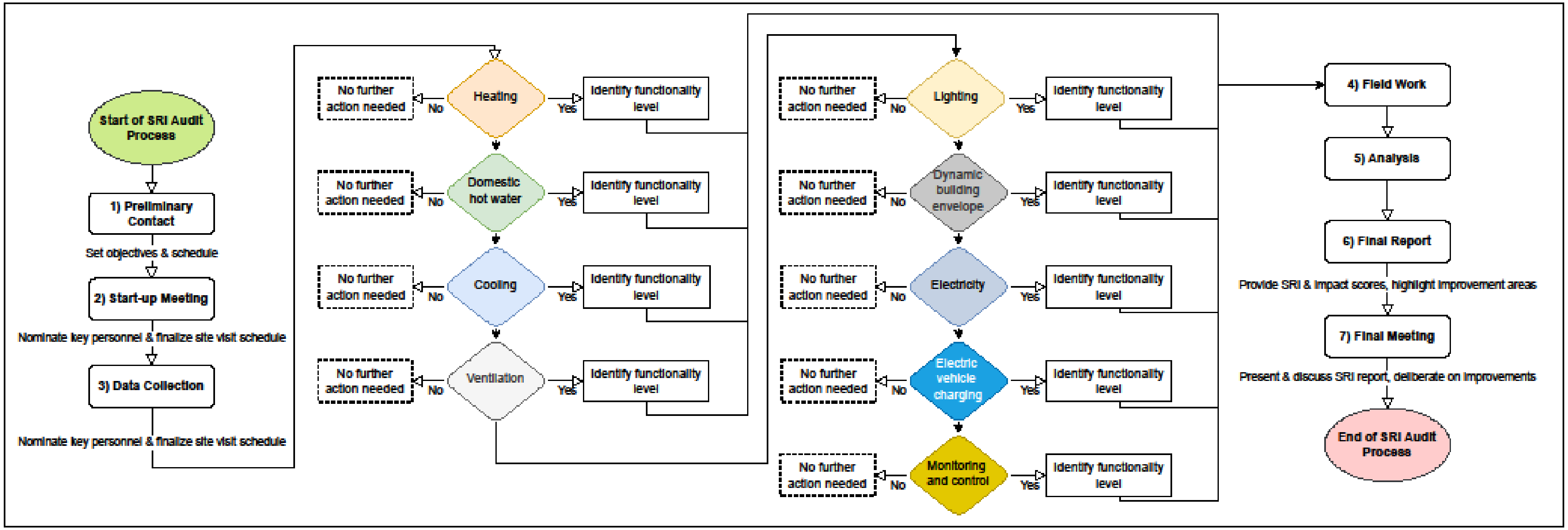


Figure 4 — Step-by-Step SRI Audit procedure

7 Documentation and Reporting

7.1 Procedure for Audit On-Site Smart Readiness Indicator (SRI) Assessment

The template, which the SRI Auditor will have on hand during the SRI on-site procedures, is conveniently located in Annex B 1 for easy access. This template features designated spaces for the Auditor to input essential building information and tick boxes to specify the functionality levels across various domains. The intuitive design of this template streamlines the on-site auditing process. By filling in this template during the on-site visit, the Auditor lays the foundation for swift and accurate data entry into the Smart Ready Go! Tool, delivered by the Smart Square project. This efficient workflow ensures that the Auditor can quickly derive the results for the Smart Readiness Indicator (SRI) assessment, thus facilitating a seamless and effective evaluation process.

The template is organized into two primary sections to facilitate the audit process. The initial section pertains to building information. Within this section, the Auditor is tasked with entering comprehensive details about the building, which will serve as the foundational data for the evaluation. Post-site visit, this data should be accurately transferred to the Smart Ready Go! Tool for further analysis and assessment.

Moving on to the domain sections, services are categorized based on their respective locations within the building, rather than following a fixed order. It's imperative for the Auditor to exercise caution and precision when completing the Smart Ready Go! Tool. Ensuring that the correct functionality level corresponds with the appropriate code for each service is essential to generate accurate and reliable results for the Smart Readiness Indicator assessment. Attention to detail in this aspect is crucial for a successful evaluation.

7.2 Step-by-step example

To ensure a comprehensive assessment, auditors are guided through a structured process to complete the on-site template and seamlessly transfer the data into the Excel calculator. Below is an illustrative example of the procedure

7.2.1 Building Information Entry:

Start by filling in the essential building information at the top of the template. The following details are required and should be entered by the Auditor:

- Date of the Audit
- Auditor's Name
- Useful Floor Area
- Building Type
- Year of Construction
- Building Address
- Building state (Renovated or Original)

In the example provided below, italicized text represents the data that the Auditor should enter.

Date	*25/11/2023*		Assessor Name	*User1*
Total useful floor area of the building	*250*	m²	Building type	*Residential*
Year of construction	*2014*		Building state	*Original*
Address	*11 Nicosia, Cyprus*			

Figure 5 — Example how to fill in the building information data

7.2.2 Domain Selection:

In the 'Domain Present' section of the template, the Auditor should meticulously assess the building's domains and place ticks in the boxes that correspond to the domains present within the building. As an example, below is a representation of a building that includes domains such as heating, cooling, domestic hot water, lighting, dynamic building envelope and electricity.

Domain present			
Heating	☒	Lighting	☒
Domestic hot water	☒	Dynamic building envelope	☒
Cooling	☒	Electricity	☒
Ventilation	☐	Electric vehicle charging	☐
Monitoring and control	☐		

Figure 6 — Example how to fill in the Domain present section

7.2.3 Service Functionality Assessment:

In the assessment of service functionality, the Auditor evaluates the functionality levels of various building services. These services are categorized into different domains, and within each domain, they are further divided into specific service groups. This categorization helps the Auditor efficiently group and assess the services during the audit.

For example, within the heating system domain, there are several service categories, including 'Heat Generator,' 'Thermal Energy Storage,' and 'Heating Water Supply and Return.' The Auditor's task is to assign the appropriate functionality level to each service based on the criteria provided in the template. It's crucial to ensure that the assigned functionality level accurately represents the current state of each service within the building.

As an example, consider Figure 7 below, which depicts the template checked for the 'Dynamic Building Envelope System' domain. Under the 'Window Control' category, the building is equipped with manually controlled blinds, and the windows are fixed, with no communication with the HVAC system. In the 'Report Information' category, there is no available reporting regarding the performance of the dynamic building envelope systems.

Dynamic Building Envelope System			
Window control			
DE-1	Window solar shading control	No sun shading or manual only	☐
		Motorized with manual control	☒
		Motorized with automatic sensor control	☐
		Combined light/blind/HVAC control	☐
		Predictive blind control (based on weather forecast)	☐
DE-2	Window open/closed control, combined with HVAC system	Manual operation or fixed windows only	☒
		Open/closed detection for HVAC control	☐
		Level 1: Automated window opening based on room sensors	☐
		Level 2: Centralized coordination of operable windows (e.g., for night cooling)	☐
Report information			
DE-4	Reporting information regarding performance of dynamic building envelope systems	No reporting	☒
		Product position and fault detection	☐
		Product position, fault detection, and predictive maintenance	☐
		Product position, fault detection, predictive maintenance, and real-time sensor data (wind, lux, temperature...)	☐
		Product position, fault detection, predictive maintenance, real-time, and historical sensor data (wind, lux, temperature...)	☐

Figure 7 — Example how to fill in the Service functionality levels section

8 Quality requirements

8.1 SRI auditor

8.1.1 Competency

The SRI auditor shall be suitably qualified (according to local guidelines and recommendations or as defined in Competence of SRI auditors) and experienced for the type of work being undertaken and for the agreed scope, aim and thoroughness.

8.1.2 Confidentiality

The SRI auditor shall treat as confidential all information provided by the organisation or disclosed during the SRI audit.

8.1.3 Objectivity

The SRI auditor shall treat the organisation's interests as paramount and act in an objective manner. The energy auditor shall ensure that the requirements apply to its subcontractors, if any.

8.1.4 Transparency

If the SRI auditor has business goals, product and process or marketing involvement that might be in conflict with the SRI audit, the SRI auditor shall disclose any conflict of interests in a transparent way.

8.2 SRI audit process

The SRI audit shall be:

a) Appropriate: suitable to the agreed scope, aims and thoroughness;

b) Complete: in order to define the audited object and the organisation;

c) Representative: in order to collect reliable and relevant data;

d) Traceable: in order to trace the origin and processing of data;

e) Useful: in order to include the recommendations for Smart Readiness Improvement Actions (SRIA);

f) Verifiable: in order to allow the organisation to monitor the results of implemented SRIA.

9 Competence of SRI auditors

9.1 Personal attributes

A clear understanding between the organisation and the SRI auditor is crucial for the success of the assignment. Effective communication maximises understanding, creates confidence and minimises risks.

The SRI auditor shall have good communication skills. This includes moderation and presentation skills.

The SRI auditor shall be experienced in communicating with technical and non-technical persons at various levels within the organisation such that the SRI auditor is able to advise in an adequate manner on all aspects (technical, economic, and others) of the SRI audit.

9.1.1 Professional skills

The SRI auditor should demonstrate the following professional skills:

- Capacity for observation, measurement, analysis, and synthesis;
- Ability to articulate concepts and ideas;
- Ability to adapt to encountered situations;
- Ability to make concrete proposals for improvements;
- Project management and methodology skills.

9.1.2 Ethical principles

The SRI auditor shall only accept those assignments that the SRI auditor is able to fulfil in a professional manner in accordance with the present document.

The SRI auditor shall, at all times, operate under the requirements and principles given in Principles for Conducting On-Site SRI Audits.

The SRI auditor shall have the ability to act in an impartial and objective manner.

9.2 Knowledge and skills

9.2.1 General knowledge and skills

9.2.1.1 SRI audit process

The SRI auditor shall possess the appropriate competence to understand and be able to apply SRI audit principles and methodology described in the present document as relevant.

The SRI auditor shall be aware of and consider specific national and local SRI auditing guidelines as well as other related standards or related documents.

9.2.1.2 Project management

The SRI auditor shall be able to manage the complete SRI audit process, including:

- Planning the SRI audit in co-operation with the organisation;
- Conducting the SRI audit within the agreed time schedule;
- Making effective use of resources during the SRI audit;
- Managing the uncertainty of achieving the SRI audit objectives;
- Ability to co-operate with all parties during the SRI audit process;
- Preventing and resolving conflicts;
- Ensuring the SRI audit complies with the relevant health, safety, environmental and security requirements;
- Coordinating other members of the SRI audit team, if any;
- Documenting SRI audit findings and preparing appropriate SRI audit reports.

9.2.2 Specific knowledge and skills

9.2.2.1 Regulatory and standard framework

The SRI auditor shall have adequate knowledge of the relevant laws, policies, rules, regulations and standards that govern his or her services in the country where the SRI auditing activities are being carried out.

9.2.2.2 Technical Building Systems

The SRI auditor shall:

- Have knowledge of physical principles related to energy (thermal, electrical, thermodynamics, heat transfer, fluid mechanics, etc.);
- Have specific knowledge and skills appropriate to procedures, activities, energy uses and technologies related to the building sector. Particularly on the technical building systems and sub-systems related relevant for the SRI's technical domains and services.

9.2.2.3 Building Operation and Management

The SRI auditor shall:

- Have foundational knowledge of building management practices, including operational efficiency, preventive and predictive maintenance, and performance optimization.
- Understand the principles of facility management and operational processes for technical building (sub-)systems relevant for the SRI's technical domains and services.
- Possess specific knowledge in the functionalities and interoperability of smart systems within buildings, covering monitoring, control, and automated adjustment.
- Be familiar with best practices and standards for data privacy and cybersecurity related to building management systems.
- Be able to assess the building's capacity for energy flexibility, demand response, and interaction with smart grids.
- Understand user interaction with smart building systems, including interfaces and occupant-centric controls, and their impact on operational efficiency and comfort.

9.2.2.4 Analysis methods

The SRI auditor shall have knowledge and skills in analysis methods, presentation and results reporting.

The SRI auditor shall identify suitable assessment tools.

The SRI auditor shall have the skill to summarise findings and data supplied and analyse it to produce suitable recommendations.

The SRI auditor shall be able to:

- Confirm the sufficiency and appropriateness of the information to support SRI audit findings and conclusions;
- Assess those factors that may affect the reliability of the SRI audit findings and conclusions;
- Understand the appropriateness and consequences of using sampling techniques for SRI auditing.

9.2.2.5 Smart readiness

The SRI auditor shall be able to establish the existing smart readiness situation of the assessed object leveraging the information gathered in previous phases. This situation becomes a reference against which improvements can be estimated.

The existing smart readiness situation shall include for the assessed object:

- Overview of the applicable technical domains, on account of the presence of related technical building (sub-)systems;
- For each present technical domain, overview of the applicable smart-ready services;
- For each applicable smart-ready service, functionality levels assigned.

9.2.2.6 Economic assessment

The SRI auditor shall be able to make suitable economic assessment of the SRI improvement opportunities proposed.

EXAMPLE Life-cycle cost analysis (LCCA), payback period, rate of return on investment, discounted cash flow, net present value.

For the economic assessment, the SRI auditor shall have the skill and experience to evaluate and consider:

- Lifetime of equipment;
- Related costs (e.g., energy, investment, maintenance and operational);
- Financial incentive measures (e.g., subsidies, tax credit, feed-in tariff, white certificates, carbon tariffs);
- The evolution of the tariff structure, energy prices and energy costs to the organisation.

The added value of automation, control, and building management functions extends beyond energy savings. While standardized methodologies exist to economically assess impacts on energy performance and operational efficiency, there are still methodological gaps in monetizing impacts related to energy flexibility, storage, and responsiveness to user needs. As methodologies in these areas evolve, the SRI auditor should be prepared to upskill accordingly.

9.3 Acquisition, maintenance and improvement of competence

9.3.1 General requirements

The SRI auditor shall demonstrate suitable education, work experience and training to allow him or her to carry out an SRI audit.

The SRI auditor competence shall be based on a combination of the following:

- Education that contributes to the development of knowledge and skills in technical disciplines related to the building sector;
- Work experience in a relevant technical, managerial or professional position involving the exercise of judgement, decision making, problem solving and communication with managers, professionals, peers, customers and other interested parties;
- Credentials and experience in SRI audits acquired under the supervision of an SRI auditor with appropriate skills in the same discipline or sector;

The SRI auditor shall establish and maintain a record of his or her technical skills and knowledge.

9.3.2 Initial education

The SRI auditor's initial technical knowledge in the smartness of buildings can be defined by a national awarding body or equivalent.

EXAMPLE Science, technology or engineering

9.3.3 Work experience

The SRI auditor's work experience in the smartness of buildings can be defined by a national awarding body or equivalent.

Consideration for general competence criteria relevant to SRI auditing shall be given to the following:

- Recent experience;
- Professional credentials;
- Demonstrated skills.

The SRI auditor shall have a suitable professional experience in the building sector the SRI auditor expects to work in.

When requested by an organisation or a national awarding body or equivalent, the SRI auditor shall prove his or her relevant professional experience with sample reports of SRI audits carried out in the recent past.

9.3.4 Training and Accreditation

The SRI auditor shall attend a training process for SRI auditing methodology when required by the national body or equivalent to be accredited as an expert eligible to issue SRI certificates.

The SRI auditor can increase his or her knowledge by training and gain experience by participating in more complex SRI auditing activities with an experienced SRI auditor.

9.3.5 Maintenance and improvement of competence

The SRI auditor shall maintain and improve general knowledge and skills on SRI audit methodology and also about the modifications of national SRI auditing guidelines, latest news in the field of smartness, smart technologies, assessment tools, etc.

The SRI auditor shall demonstrate the maintenance and improvement of suitable and recognised skills, experience and expertise.

The SRI auditor shall update and improve the necessary technical knowledge and skills from:

- Professional training which may be sector or technology specific, as appropriate;

EXAMPLE Lighting, HVAC, building automation, energy management systems

- Participation in conferences and/or seminars;
- Reading technical journals;
- Internships;
- Participation in SRI audits in more complex organisations and/or in other sectors.

Annex A
(informative)

Review of Regulations and Standards

A.1 Implementation and Integration of the Smart Readiness Indicator in the Revised EPBD

The recast of the Energy Performance of Buildings Directive (EPBD) (2175/2024) establishes the Smart Readiness Indicator (SRI) as a crucial tool for enhancing the energy efficiency and smart capabilities of buildings across the European Union. This initiative is part of the EU's broader goal to achieve a zero-emission building stock by 2050.

The European Commission, as outlined in Article 15, is tasked with developing and adopting a common Union scheme for the SRI, which will include a definition of the indicator and a detailed methodology for its calculation. This methodology will evaluate various aspects of a building's smart capabilities, such as the presence of smart meters, building automation systems, self-regulating devices, and the ability to participate in demand-response activities. Additionally, the methodology may consider the existence of a digital twin, which is a real-time, dynamic simulation of the building's performance, enhancing the building's energy efficiency.

By 30 June 2026, the Commission must report to the European Parliament and the Council on the progress of the SRI's testing and implementation, based on national test phases and relevant projects. Depending on the outcomes of this report, the Commission may make the application of the SRI mandatory for non-residential buildings with significant heating, cooling, and ventilation capacities (over 290 kW) by 30 June 2027, as specified in Article 15.

Member States, under the requirements of Article 22, are required to integrate the SRI into their national frameworks for energy performance, ensuring that it complements existing energy performance certificates and other relevant assessments. The data from the SRI will be included in national databases, allowing for comprehensive monitoring and analysis of building energy performance. These databases must be interoperable and integrated with other administrative systems, such as national building cadastres or land registries.

To ensure the credibility and consistency of the SRI, Articles 25 and 27 mandate that Member States employ independent and certified experts for its assessment and establish independent control systems to oversee the process. The SRI framework is designed to be transparent, user-friendly, and compatible with existing national schemes, providing clear and actionable information to building owners, occupants, and investors, while also respecting data protection and cybersecurity requirements as outlined in Annex IV.

A.2 EU Regulation 2020/2155

SRI was established as a voluntary, standardized European Union scheme for assessing and rating the smart readiness of buildings in the Delegated Regulation (EU) 2020/2155. The SRI is designed to evaluate and communicate how effectively buildings use smart technologies to enhance energy efficiency, adapt to occupants' needs, and integrate with the grid.

The regulation has several key objectives. It aims to:

1. **Promote Energy Efficiency**: By integrating smart technologies, buildings can optimize energy consumption, contributing to the EU's 2030 energy efficiency goals.

2. **Facilitate Modernization**: Encourage the adoption of smart technologies, such as AI and cloud-based systems, across the EU's building stock.

3. **Ensure Consistency and Transparency**: Establish a common methodology for calculating and rating the smart readiness of buildings to ensure uniformity across the EU while allowing flexibility for adaptation to specific national conditions.

The SRI is a comprehensive tool for evaluating a building's smart capabilities. It measures the building's ability to:

- Improve energy efficiency;
- Enhance user comfort and convenience;
- Adapt to energy demands and integrate with the grid;
- Provide additional benefits like health and well-being, accessibility, and preparedness for climate change.

The SRI is calculated based on the smart-ready services present in a building, their functionality, and the overall performance across various technical domains like heating, cooling, and lighting. The regulation also emphasizes that the SRI is distinct from energy performance certificates, although it can complement them.

The regulation provides a detailed methodology for calculating the SRI. This involves assessing the smart-ready services in a building, which are catalogued in the regulation's annexes. The methodology includes predefined weighting factors for different building types, climates, and functions, ensuring that the SRI accurately reflects a building's smart capabilities. The resulting SRI is expressed as a percentage score, which can be disaggregated into specific functionalities and impact criteria, such as energy efficiency, comfort, and flexibility.

The SRI scheme is optional for EU Member States, meaning they can choose whether to implement it and to what extent (e.g., for certain building categories). Member States can also integrate the SRI with existing national energy performance certification schemes, avoiding duplication of efforts. They are responsible for establishing control systems to ensure the validity of SRI certificates, and for setting up qualification criteria for experts who will assess and certify the smart readiness of buildings.

The regulation acknowledges the increased risks associated with greater digitization and connectivity in buildings. It emphasizes the need for building owners and users to be informed about potential cybersecurity and data protection risks, ensuring that smart technologies are implemented safely and responsibly.

A.3 EU Regulation 2020/2156

The European Union (EU) Commission has taken a significant step forward in its commitment to fostering a more energy-efficient and technologically advanced built environment. EU Commission **Implementing Regulation 2020/2156**, dated 14 October 2020, lays out the technical intricacies for a common Union scheme designed to rate the smart readiness of buildings. This forward-thinking regulation aligns with the EU's overarching goal to create a smarter, more sustainable, and energy-efficient building ecosystem.

At its core, the regulation seeks to achieve several pivotal objectives that can revolutionize the way buildings are assessed, marketed, and experienced:

- **Establishing a Common Union Scheme**: The primary objective is to establish a unified scheme that can be applied consistently across the EU. This common framework ensures that the assessment of a building's smart readiness is standardized, transparent, and applicable across diverse regions.
- **Promoting Smart Technology Integration**: The regulation encourages the integration of smart technologies in buildings with the aim of enhancing energy efficiency and overall user

comfort. This shift towards smart buildings represents a significant stride in modernizing the real estate sector and aligns with broader sustainability goals.

- **Providing Transparency**: Transparency is a fundamental goal of this regulation. It seeks to provide end-users and stakeholders with clear and comprehensive information about a building's smart capabilities. This transparency empowers potential occupants, investors, and industry stakeholders to make informed decisions.

The regulation outlines several key provisions that serve as the backbone of the smart readiness rating system:

- **Assessment Criteria**: The regulation meticulously details the criteria for assessing buildings. These criteria are laser-focused on evaluating a building's capacity to adapt to the needs of its occupants and the broader energy grid. The emphasis is on enhancing energy efficiency and overall performance, aligning with the EU's sustainability objectives.
- **Indicators**: A set of quantifiable indicators is defined within the regulation. These indicators serve as the yardstick for measuring the smart readiness of a building. They are carefully structured to allow for consistent comparisons across different buildings and regions, creating a level playing field for the assessment process.
- **Reporting and Rating**: To ensure transparency and comprehensiveness, the regulation specifies how the smart readiness of a building should be reported. It outlines the format and content requirements for these reports. This ensures that the information presented to end-users and stakeholders is not only accurate but also clear, facilitating an in-depth understanding of a building's smart capabilities.

The implications of EU Commission Implementing Regulation 2020/2156 are far-reaching and have a significant impact on various stakeholders in the real estate and technology industries:

- **For Building Owners and Developers**: This regulation presents a standardized and systematic approach for showcasing the smart readiness of buildings, as well as for understanding and identifying the most appropriate areas for improvements. Building owners and developers can leverage this rating as a unique selling proposition in the competitive real estate market. By displaying the smart capabilities of their properties, they can attract environmentally conscious and tech-savvy investors and occupants.
- **For End-Users**: Potential occupants now have access to comprehensive information about a building's smart capabilities. This empowers them to make informed decisions based on their preferences and requirements. It ensures that end-users get the best value for their investment and that their living or working environments align with their expectations.
- **For the Smart Tech Industry**: The establishment of a standard rating system creates a clear path for technology providers to align their solutions with the criteria outlined in the regulation. This alignment can potentially boost the adoption of smart technologies in buildings. As providers tailor their offerings to meet the smart readiness standards, they contribute to the growth of the smart tech industry, furthering innovation, and sustainability.

EU Commission Implementing Regulation 2020/2156 embodies the EU's forward-thinking and progressive approach to shaping a smarter, more energy-efficient, and sustainable built environment. By setting out precise criteria for rating the smart readiness of buildings, this regulation not only enhances transparency but also promotes innovation and investment in smart technologies. The result is a real estate sector that is better equipped to meet the challenges of the future, from energy efficiency to user comfort, and ultimately, contributing to the broader goals of environmental sustainability and quality of life. This regulatory initiative serves as a model for the integration of smart technologies in building infrastructure worldwide.

A.4 EN 16247 Energy Audit Standard

Energy audits of buildings are pivotal in addressing the growing global concern over energy consumption and environmental sustainability. These audits, conducted in accordance with the EN 16247 standard, offer a comprehensive framework to assess and optimize a building's energy performance. The EN 16247-2 standard, established by the European Committee for Standardization (CEN), provides guidelines for the harmonized evaluation of energy use in buildings.

At the heart of the EN 16247 standard lies a systematic and rigorous approach to energy auditing, covering diverse aspects from data collection to the development of energy-saving strategies. Energy auditors, following this standard, meticulously evaluate a building's energy consumption, taking into account heating, cooling, lighting, and other systems, to identify areas for improvement. This process involves the assessment of technical systems, building envelope efficiency, and the holistic performance of the building itself.

The information gleaned from these audits empowers building owners, managers, and operators to make informed decisions to enhance energy efficiency and reduce operational costs. In addition to financial benefits, energy audits conducted in line with EN 16247 contribute to environmental sustainability by curbing energy waste and reducing greenhouse gas emissions.

Energy audits in accordance with EN 16247 represent a vital step toward creating more energy-efficient and environmentally responsible buildings, aligning with global efforts to combat climate change and create a greener, more sustainable future.

Annex B
(informative)

Supporting information, including case studies, best practice examples, and templates

B.1 Building Information

Date			Assessor Name	
Total useful floor area of the building		m²	Building type	
Year of construction			Building state	
Address				

Domain present			
Heating	☐	Lighting	☐
Domestic hot water	☐	Dynamic building envelope	☐
Cooling	☐	Electricity	☐
Ventilation	☐	Electric vehicle charging	☐
Monitoring and control	☐		

B.2 Heating

Heating System			
Heat Generator			
H-2a	Heat generator control (all except heat pumps)	Constant temperature control	☐
		Variable temperature control based on outdoor temperature	☐
		Variable temperature control based on load (e.g., supply water temperature set point)	☐
H-2b	Heat generator control (for heat pumps)	On/Off control of heat generator	☐
		Multi-stage control of heat generator capacity based on load or demand (e.g., compressor On/Off)	☐
		Variable control of heat generator capacity based on load or demand (e.g., hot gas bypass, inverter frequency control)	☐
		Variable control of heat generator capacity based on load and external grid signals	☐
H-2d	Sequencing in case of different heat generators	Priority control based on running time	☐
		Control based on a fixed priority list (e.g., rated energy efficiency)	☐

		Control based on a dynamic priority list (current energy efficiency, carbon emissions, generator capacity)	☐
		Control based on a dynamic priority list (current and predicted load, energy efficiency, carbon emissions, generator capacity)	☐
		Control based on a dynamic priority list (current and predicted load, energy efficiency, carbon emissions, generator capacity, and external grid signals)	☐
Thermal energy storage			
H-1c	Storage and shifting of thermal energy	None	☐
		Available HW storage vessels	☐
		HW storage vessels controlled by external signals (BACS or grid)	☐
H-1f	Thermal Energy Storage (TES) for building heating (excluding TABS)	Continuous storage operation	☐
		Time-scheduled storage operation	☐
		Load prediction-based storage operation	☐
		Heat storage with flexible grid control (e.g., DSM)	☐
Heating water supply and return			
H-1d	Control of distribution pumps in networks	No automatic control	☐
		On/off control	☐
		Multi-stage control	☐
		Variable speed pump control (internal estimations)	☐
		Variable speed pump control (external demand signal)	☐
Room			
H-1a	Heat emission control	No automatic control	☐
		Central automatic control (e.g., central thermostat)	☐
		Individual room control (e.g., thermostatic valves or electronic controller)	☐
		Individual room control with communication	☐
		Individual room control with communication and occupancy detection	☐
H-1b	Emission control for TABS (heating mode)	Advanced central automatic control	☐
		Advanced central automatic control with intermittent operation and room temperature feedback control	☐
		No automatic control	☐
		Central automatic control (e.g., central thermostat)	☐

Grid and report information			
H-3	Report information regarding heating system performance	None	☐
		Central or remote reporting of current performance KPIs	☐
		Central or remote reporting of current and historical performance data	☐
		Central or remote reporting of performance evaluation, including forecasting and benchmarking	☐
		Central or remote reporting of performance evaluation, forecasting, benchmarking, and predictive management with fault detection	☐
H-4	Flexibility and grid interaction	No automatic control	☐
		Scheduled heating system operation	☐
		Self-learning heating system control	☐
		Flexible grid-controlled heating system (e.g., DSM)	☐
		Optimized heating system control based on local predictions and grid signals (e.g., model predictive control)	☐

B.3 Domestic Hot Water

Domestic Hot Water Heating System			
Solar Collector			
DHW-1d	Control of DHW storage charging (with solar collector and supplementary heat generation)	Manual solar or heat generation control	☐
		Automatic solar storage charge control (Prio. 1) and supplementary charge	☐
		Automatic solar storage charge control (Prio. 1), supplementary charge, and demand-based supply or multi-sensor management	☐
		Automatic solar storage charge control (Prio. 1), supplementary charge, demand-based supply, return temperature control, and multi-sensor management	☐
Boiler/district heating pump			
DHW-1a	Control of DHW storage charging (with direct electric heating or integrated electric heat pump)	Automatic on/off control	☐
		Automatic on/off control with scheduled charging	☐
		Automatic on/off control with scheduled charging and multi-sensor management	☐
Domestic hot water storage			
DHW-1b	Control of DHW storage charging	None	☐
		Available HW storage vessels	☐
		Automatic charging control based on local renewables or grid info (DR, DSM)	☐
Heating water supply and return			
DHW-2b	Sequencing in case of different DHW generators	Running time priorities	☐
		Fixed priority list (e.g., based on energy efficiency)	☐
		Dynamic priority list (current energy efficiency, carbon emissions, generator capacity)	☐
		Dynamic priority list (current and predicted load, energy efficiency, carbon emissions, generator capacity)	☐
		Dynamic priority list (current and predicted load, energy efficiency, carbon emissions, generator capacity, grid signals)	☐
Grid and report information			
DHW-3	Report information regarding domestic hot water performance	None	☐
		Actual values (e.g., temperatures, energy usage)	☐
		Actual values and historical data	☐
		Performance evaluation with forecasting and benchmarking	☐
		Performance evaluation with forecasting, benchmarking, predictive management, and fault detection	☐

B.4 Cooling

Cooling System			
Chiller			
C-1f	Interlock: avoiding simultaneous heating and cooling in the same room	No interlock	☐
		Partial interlock (minimizing simultaneous heating and cooling risk)	☐
		Total interlock (prevents simultaneous heating and cooling)	☐
C-2a	Generator control for cooling	On/Off cooling production control	☐
		Multi-stage cooling production control based on load or demand	☐
		Variable cooling production control based on load or demand	☐
		Variable cooling production control based on load and grid signals	☐
C-2b	Sequencing of different cooling generators	Running time priorities	☐
		Fixed sequencing based on load characteristics (e.g., absorption chiller vs. centrifugal chiller)	☐
		Dynamic priorities based on generator efficiency and characteristics (e.g., free cooling availability)	☐
		Load prediction-based sequencing (COP, available power, predicted demand)	☐
		Sequencing based on dynamic priority list, including grid signals	☐
Thermal energy storage			
C-1g	Control of Thermal Energy Storage (TES) operation	Continuous storage operation	☐
		Time-scheduled storage operation	☐
		Load prediction-based storage operation	☐
		Grid-controlled cold storage (e.g., DSM)	☐
Chilled water supply and return			
C-1c	Control of distribution network chilled water temperature (supply or return)	Constant temperature control	☐
		Outside temperature compensation control	☐
		Demand-based control	☐
C-1d	Control of distribution pumps in networks	No automatic control	☐
		On/off control	☐
		Multi-stage control	☐
		Variable speed pump control (internal estimation)	☐
		Variable speed pump control (external demand signal)	☐
Room			
C-1a	Cooling emission control	No automatic control	☐

		Central automatic control	☐
		Individual room control	☐
		Room control with communication to BACS	☐
		Room control with communication and occupancy detection	☐
C-1b	Emission control for TABS (cooling mode)	No automatic control	☐
		Central automatic control	☐
		Advanced central control	☐
		Advanced central control with intermittent operation and room feedback	☐
Grid and report information			
C-3	Report information regarding cooling system performance	None	☐
		Reporting of current performance KPIs	☐
		Reporting of current performance KPIs and historical data	☐
		Reporting of performance evaluation with forecasting and benchmarking	☐
		Reporting of performance evaluation with forecasting, benchmarking, predictive management, and fault detection	☐
C-4	Flexibility and grid interaction	No automatic control	☐
		Scheduled cooling system operation	☐
		Self-learning cooling system control	☐
		Cooling system with grid-responsive control (e.g., DSM)	☐
		Optimized cooling system control based on local predictions and grid signals (e.g., model predictive control)	☐

B.5 Ventilation

Ventilation System			
Heat recovery			
V-2c	Heat recovery control: prevention of overheating	No overheating control	☐
		Heat recovery modulation/bypass with exhaust sensors	☐
		Heat recovery modulation/bypass with room sensors or predictive control	☐
Outside Air			
V-3	Free cooling with mechanical ventilation system	No automatic control	☐
		Night cooling	☐
		Free cooling: airflow modulated to reduce mechanical cooling	☐
		Hx-directed control: airflow modulation based on temperature and humidity for less mechanical cooling	☐
Air handling			
V-1c	Air flow or pressure control at the air handler level	No automatic control: Continuous airflow for maximum room load	☐
		On/off time control: Continuous airflow during nominal occupancy	☐
		Multi-stage control: Reduces fan energy demand	☐
		Automatic flow/pressure control without reset: Load-dependent airflow for all connected rooms	☐
		Automatic flow/pressure control with reset (VFD systems): Load-dependent airflow with pressure reset for all rooms	☐
V-2d	Supply air temperature control at the air handling unit level	No automatic control	☐
		Constant setpoint with manual adjustment	☐
		Variable setpoint with outdoor temperature compensation	☐
		Variable setpoint with load-dependent compensation	☐
Room			
V-1a	Supply air flow control at the room level	No ventilation system or manual control	☐
		Clock-based control	☐
		Occupancy detection control	☐
		Central Demand Control based on air quality sensors	☐
		Local Demand Control based on air quality sensors with zone dampers.	☐

Grid and report information			
V-6	Reporting information regarding IAQ	None	☐
		Real-time autonomous IAQ monitoring	☐
		Real-time and historical IAQ info for occupants	☐
		Real-time and historical IAQ info for occupants + maintenance/occupant warnings	☐

B.6 Lighting

Lighting System			
Occupancy control			
L-1a	Occupancy control for indoor lighting	Manual on/off switch	☐
		Manual on/off switch with sweeping signal	☐
		Automatic detection (auto on/dimmed or auto off)	☐
		Automatic detection (manual on/dimmed or auto off)	☐
Artificial lighting			
L-2	Control artificial lighting power based on daylight levels	Manual (central)	☐
		Manual (per room/zone)	☐
		Automatic switch	☐
		Automatic dim	☐
		Automatic dim with scene-based control	☐

B.7 Dynamic Building Envelope

Dynamic Building Envelope System			
Window control			
DE-1	Window solar shading control	No sun shading or manual only	☐
		Motorized with manual control	☐
		Motorized with automatic sensor control	☐
		Combined light/blind/HVAC control	☐
		Predictive blind control (based on weather forecast)	☐
DE-2	Window open/closed control, combined with HVAC system	Manual operation or fixed windows only	☐
		Open/closed detection for HVAC control	☐
		Level 1: Automated window opening based on room sensors	☐
		Level 2: Centralized coordination of operable windows (e.g., for night cooling)	☐
Report information			
DE-4	Reporting information regarding performance of dynamic building envelope systems	No reporting	☐
		Product position and fault detection	☐
		Product position, fault detection, and predictive maintenance	☐
		Product position, fault detection, predictive maintenance, and real-time sensor data (wind, lux, temperature...)	☐
		Product position, fault detection, predictive maintenance, real-time, and historical sensor data (wind, lux, temperature...)	☐

B.8 Electricity

Electricity			
Generation			
E-5	Control of combined heat and power plant (CHP)	CHP control based on schedule and heat energy demand	☐
		CHP control based on RES availability, excess fed to grid	☐
		CHP control based on RES and grid signals, dynamic optimization for self-consumption	☐
Storage			
E-3	Storage of (locally generated) electricity	None	☐
		On-site electricity storage (e.g., electric battery)	☐
		On-site energy storage (electric battery or thermal storage) with grid-based control	☐
		On-site energy storage optimizing local electricity use	☐
		On-site energy storage optimizing local use and grid interaction	☐
E-8	Support of (micro)grid operation modes	None	☐
		Automated building-level electricity consumption based on grid signals	☐
		Automated building-level electricity consumption and supply to neighboring buildings or grid	☐
		Automated building-level electricity consumption and supply with potential for limited off-grid operation	☐
Optimization			
E-4	Optimizing self-consumption of locally generated electricity	None	☐
		Scheduled electricity consumption (plug loads, white goods, etc.)	☐
		Automated local electricity consumption management based on renewable energy availability	☐
		Automated local electricity consumption management based on current and predicted needs and renewable energy availability	☐
Report information			
E-2	Reporting information regarding local electricity generation	None	☐
		Current generation data available	☐
		Actual and historical data	☐
		Performance evaluation with forecasting and benchmarking	☐

		Performance evaluation with forecasting, benchmarking, predictive management, and fault detection	☐
E-11	Reporting information regarding energy storage	None	☐
		Current SOC data available	☐
		Actual and historical data	☐
		Performance evaluation with forecasting and benchmarking	☐
		Performance evaluation with forecasting, benchmarking, predictive management, and fault detection	☐
E-12	Reporting information regarding electricity consumption	None	☐
		Building-level electricity consumption reporting	☐
		Real-time feedback or benchmarking at the building level	☐
		Real-time feedback or benchmarking at the appliance level	☐
		Real-time feedback at appliance level with automated personalized recommendations	☐

B.9 Electric Vehicle Charging

Electric Vehicle Charging System			
Capacity			
EV-15	EV Charging Capacity	Not present	☐
		Ducting or power plug available	☐
		0-9% parking spaces with recharging points	☐
		10-50% parking spaces with recharging points	☐
		>50% parking spaces with recharging points	☐
Grid and report information			
EV-16	EV Charging Grid balancing	Not present (uncontrolled charging)	☐
		1-way controlled charging with optimization	☐
		2-way controlled charging with optimization	☐
EV-17	EV charging information and connectivity	No information available	☐
		Reporting EV charging status to occupant	☐
		Reporting EV charging status to occupant with driver identification and authorization	☐

B.10 Monitoring and Control

Monitoring and Control System			
HVAC			
MC-3	Run time management of HVAC systems	Manual setting	☐
		Scheduled runtime setting for heating and cooling plants	☐
		On/off control of heating and cooling based on building loads	☐
		On/off control of heating and cooling based on predictive control or grid signals	☐
Technical Building Services			
MC-9	Occupancy detection: connected services	None	☐
		Individual function occupancy detection (e.g., lighting)	☐
		Centralized occupancy detection (e.g., lighting and heating)	☐
MC-4	Detecting faults of technical building systems and providing support to the diagnosis of these faults	No central fault and alarm indication	☐
		Central fault and alarm indication for at least 2 relevant TBS	☐
		Central fault and alarm indication for all relevant TBS	☐
		Central fault and alarm indication for all relevant TBS, including diagnostics	☐
Override control			
MC-29	Override of DSM control	No DSM control	☐
		DSM control without user override	☐
		Manual user override of DSM control	☐
		Scheduled user override of DSM control	☐
		Scheduled override with optimized DSM control	☐
Platform			
MC-30	Single platform that allows automated control & coordination between TBS + optimization of energy flow based on occupancy, weather and grid signals	None	☐
		Platform for manual control of multiple TBS	☐
		Platform for automated TBS control and coordination	☐
		Platform for automated TBS control, coordination, and energy optimization based on occupancy, weather, and grid signals	☐
Grid and report information			
MC-25	Smart Grid Integration	No grid-TBS harmonization; building operates independently.	☐
		Individual TBS demand-side management without coordination.	☐

		Coordinated demand-side management of multiple TBS.	☐
MC-13	Central reporting of TBS performance and energy use	None	☐
		Real-time energy use reporting per energy carrier.	☐
		Real-time energy use reporting per energy carrier, combining at least 2 domains.	☐
		Real-time energy use reporting per energy carrier, combining all main domains.	☐
MC-28	Reporting information regarding demand side management performance and operation	None	☐
		Reporting DSM status, including energy flow.	☐
		Reporting historical and predicted DSM status, including energy flow.	☐

Annex C
(informative)

Data Input into the SRI Calculator

After completing the on-site template, the Auditor should proceed to input the collected data into the SRI calculator tool. Indicatively, in this report, the Smart-Ready-Go! tool, delivered within the Smart Square project, is used. This open access tool is accessible at www.smart-ready-go.eu. Smart^2 platform supports web, tablet, and mobile app interfaces and present users with intuitive forms, tables, and graphs to input and visualize data.

- **Home page**: This is the primary interface of the tool with which users interact. When a user enters the tool's URL, the home page is displayed. To assist users in getting started, the page provides a detailed user guide and video tutorials that explain the SRI concept, guide through system navigation, and instruct on how to conduct an assessment and enhance their building's intelligence.
- **Login page**: This module manages user login, registration, and access controls, ensuring that only authorized users can access certain functionalities and data.
- **Assessment**: This component processes user inputs to perform SRI assessments. It applies the calculation algorithms defined in the system's business rules to generate SRI scores and assessments. It provides features for users to view, download, and print their certificates.
- **Call Centre**: This component processes user inputs to perform SRI using the oversimplified method, questionnaire. It applies the calculation algorithms defined in the system's business rules to generate SRI scores and assessments. It provides features for users to view, download, and print their certificates.
- **Dashboard**: The statistics module enhances user engagement by offering a dashboard to benchmark their building's performance against others, thereby helping them understand how their building's smartness measures up. This dashboard will not only reveal the total number of assessments carried out through various methods in individual countries and across all nations but will also include the functionality for users to filter by country and method. Moreover, there's the functionality to view aggregate data for all EU countries using all methods. The dashboard will further detail the SRI classes available, average impact scores, and domain scores.
- **Contact Us**: This section provides users with in-depth information about the project and offers email support for those needing assistance with any issues.

Figures B.1-B.8 illustrate a visual representation of the tool's user interface and user experience design. Annex B describes a detailed example of the user registration process, the creation of an assessment via Method A or B, and the procedure for conducting an assessment through the Call Centre method.

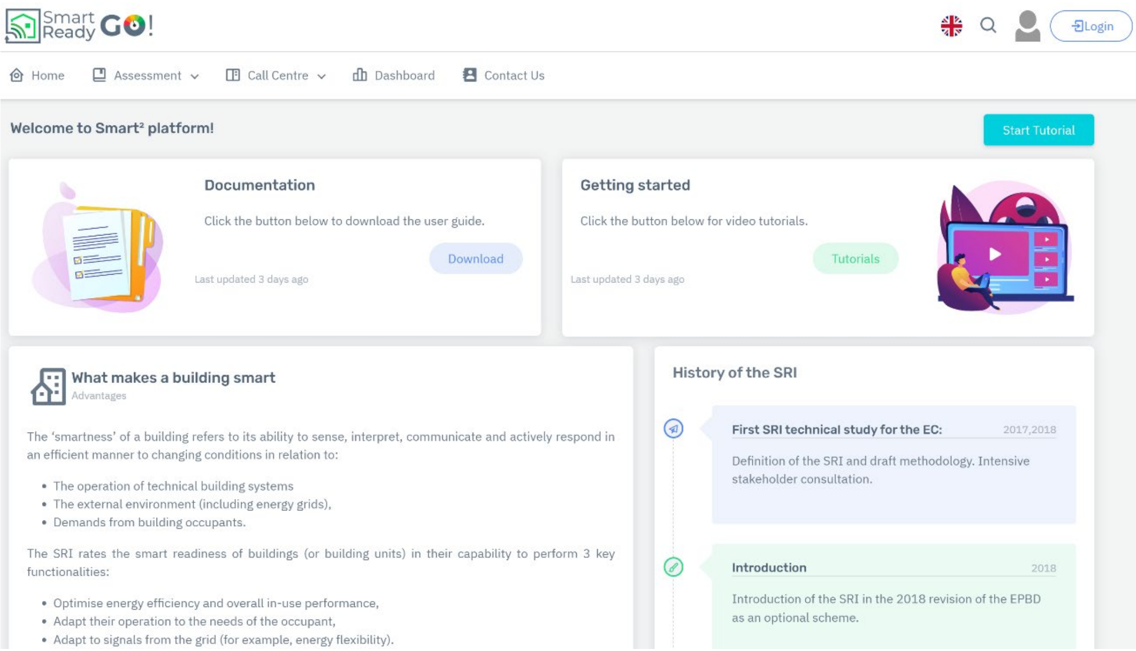


Figure C.1 — Smart2tool UI - Home page

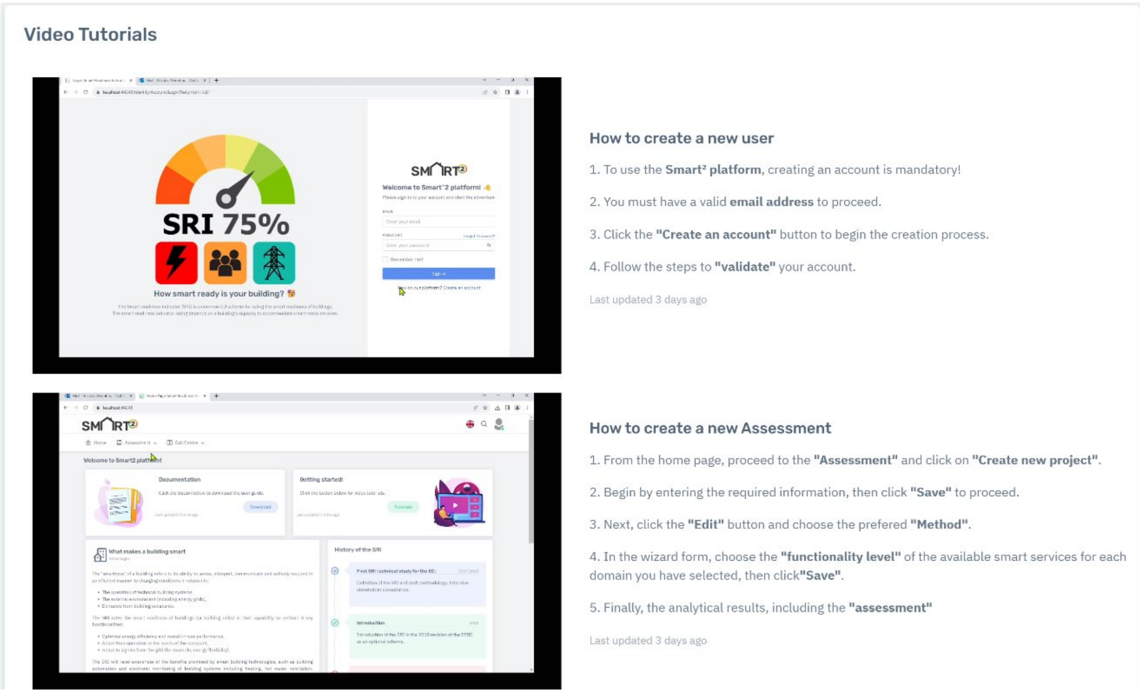


Figure C.2 — Smart2tool UI - Video tutorial page

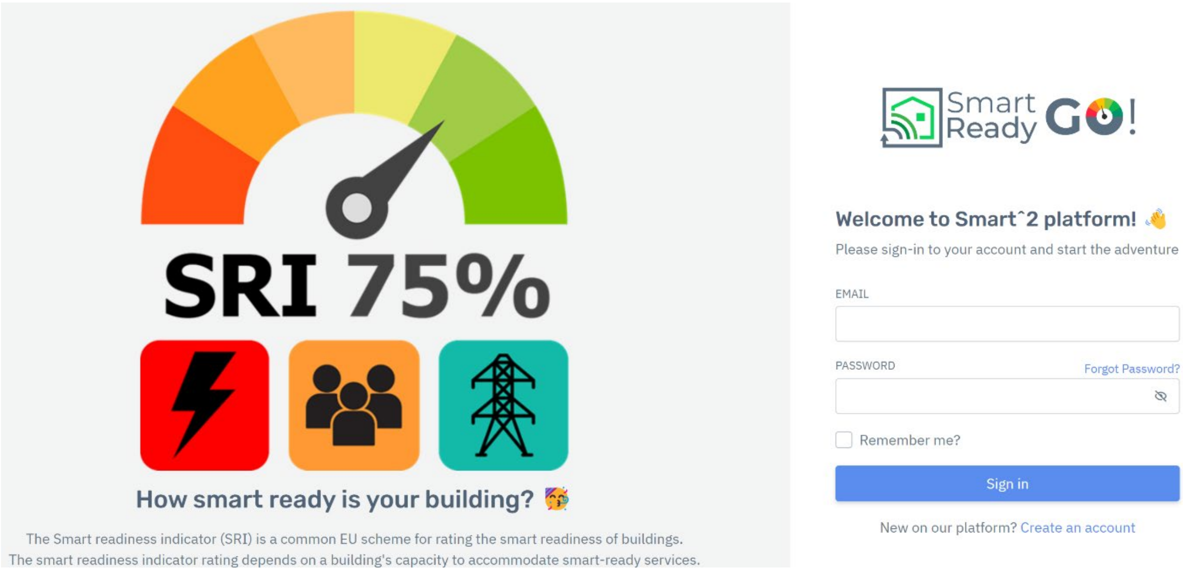


Figure C.3 — Smart2tool UI - Login page

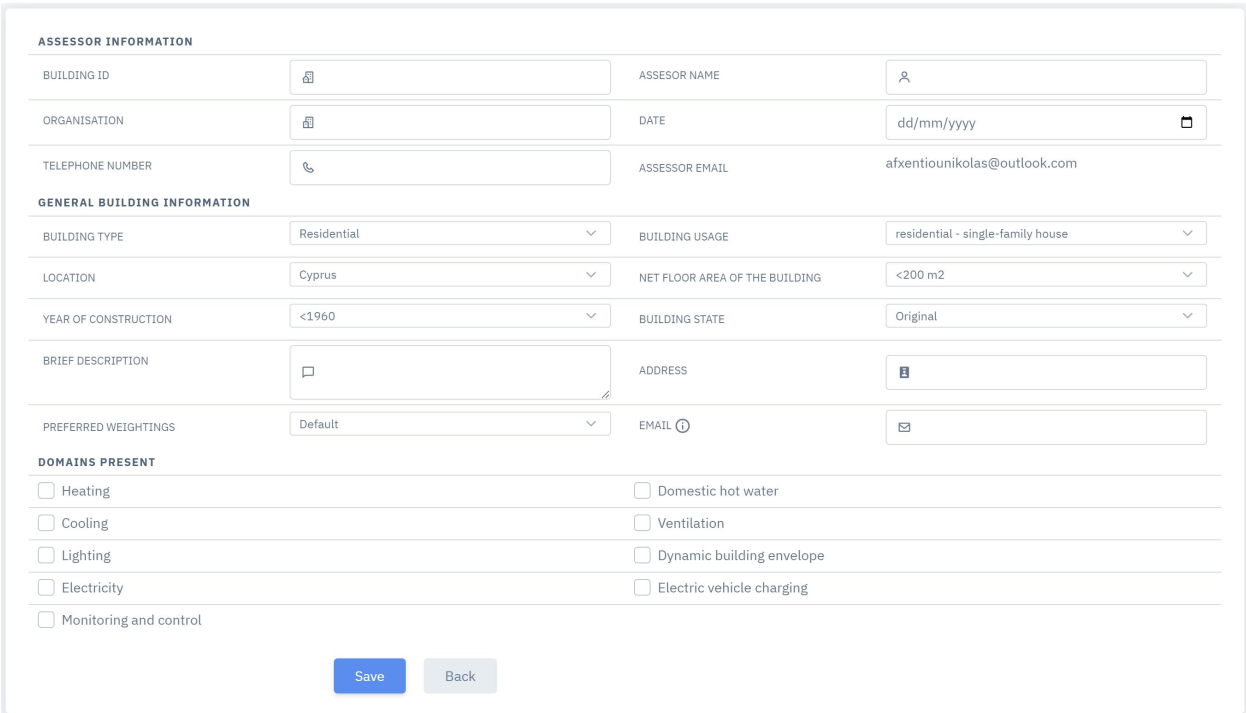


Figure C.4 — Smart2tool UI – Assessment input data

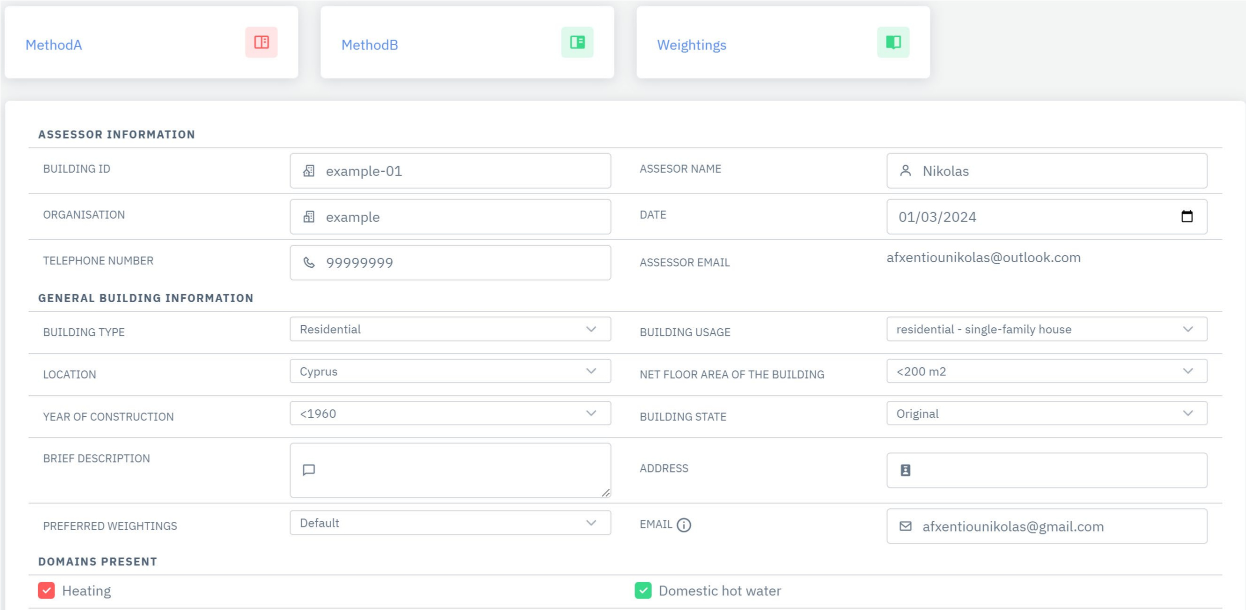


Figure C.5 — Smart2tool UI - Methods and weighting factors input data

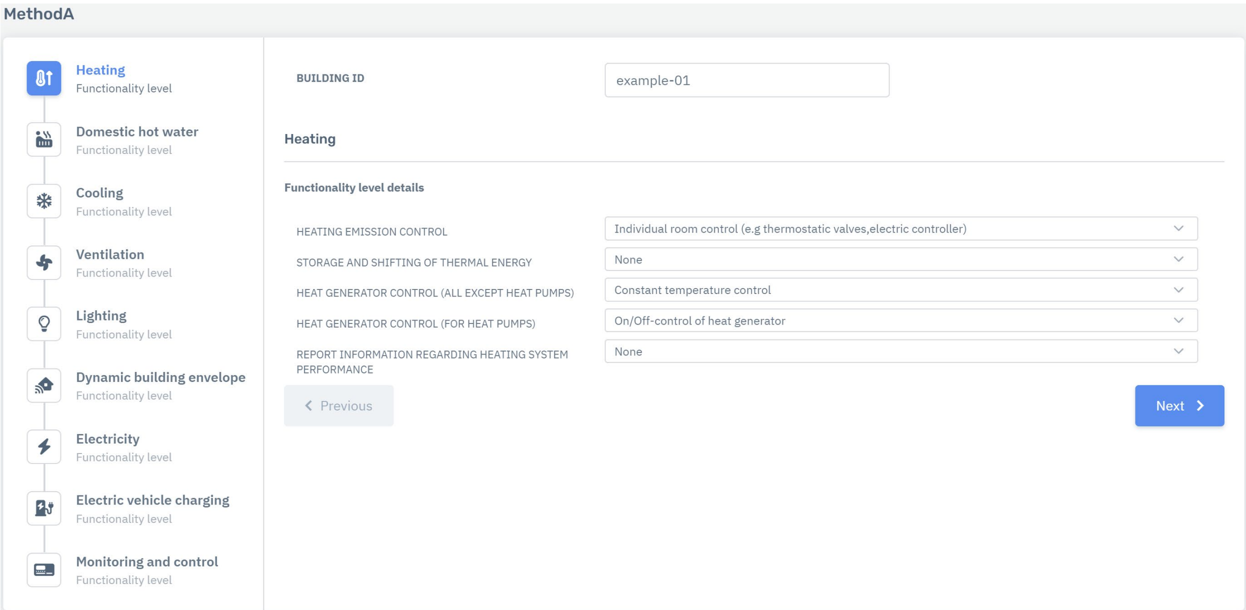


Figure C.6 — Smart2tool UI – Form wizard input data for smart services

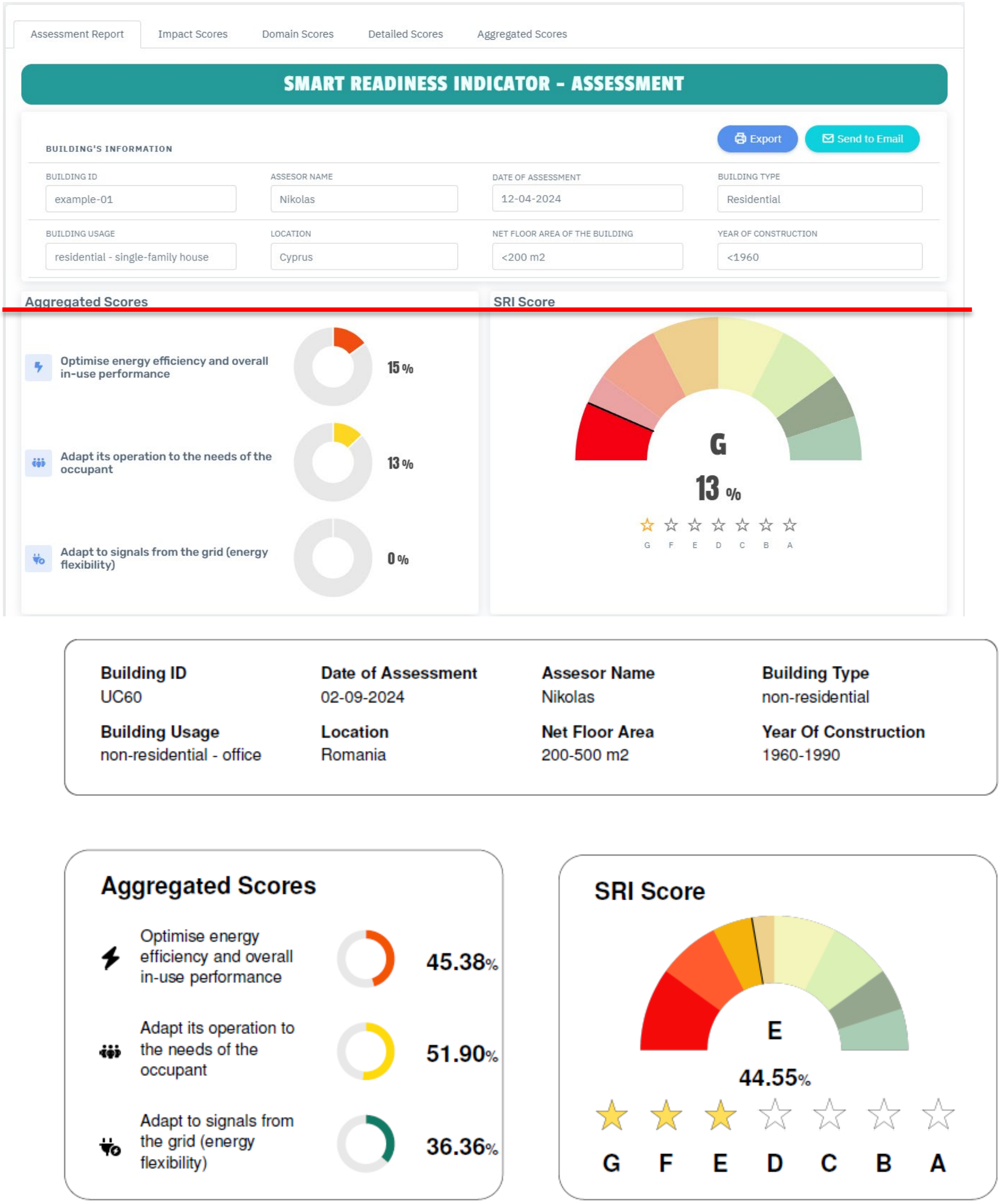


Figure C.7 — Smart2tool UI – Assessment report and analytical results

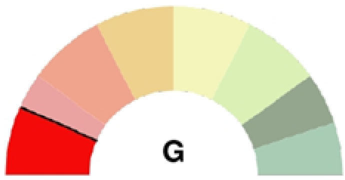
SMART READINESS INDICATOR - ASSESSMENT

Building ID	Date of Assessment	Assesor Name	Building Type
example 2	21-03-2024		residential
Building Usage	**Location**	**Net Floor Area**	**Year Of Construction**
	Cyprus	500-1.000 m2	1990-2010

Aggregated Scores

Optimise energy efficiency and overall in-use performance		10%
Adapt its operation to the needs of the occupant		10%
Adapt to signals from the grid (energy flexibility)		0%

SRI Score



13%

G F E D C B A

	Energy Efficiency	Maintenance & Fault Prediction	Comfort	Convenience	Health & Well-being	Information to Occupants	Energy Flexibility & Storage	SRI
Total	19%	0%	19%	21%	0%	0%	0%	13 %
Heating	10%	0%	14%	20%	50%	0%	0 %	
DHW	0%	0%	0%	0%	0%	0%	0 %	
Cooling	0%	0%	0%	0%	0%	0%	0 %	
Ventilation	0%	0%	0%	0%	0%	0%	0 %	
Lighting	100%	0%	100%	100%	0%	0%	0 %	
DE	0%	0%	0%	0%	0%	0%	0 %	
Electricity	0%	0%	0%	0%	0%	0%	0 %	
EV	0%	0%	0%	0%	0%	0%	0 %	
M&C	0%	0%	0%	0%	0%	0%	0 %	

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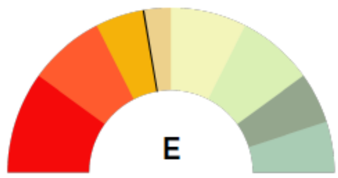
SMART READINESS INDICATOR - ASSESSMENT

Building ID	Date of Assessment	Assesor Name	Building Type
UC60	02-09-2024	Nikolas	non-residential
Building Usage	**Location**	**Net Floor Area**	**Year Of Construction**
non-residential - office	Romania	200-500 m2	1960-1990

Aggregated Scores

Optimise energy efficiency and overall in-use performance	45.38%
Adapt its operation to the needs of the occupant	51.90%
Adapt to signals from the grid (energy flexibility)	36.36%

SRI Score



44.55%

G F E D C B A

	Energy Efficiency	Maintenance & Fault Prediction	Comfort	Convenience	Health & Well-being	Iformation to Occupants	Energy Flexibility & Storage	SRI
Total	61.99%	28.77%	60.89%	48.35%	56.45%	41.90%	36.36%	44.55 %
Heating	73.68%	20%	63.64%	40%	60%	75%	27.27 %	
DHW	0%	0%	0%	0%	0%	0%	0 %	
Cooling	68.18%	40%	80%	72.73%	80%	25%	36.36 %	
Ventilation	28.57%	50%	70%	75%	66.67%	33.33%	0 %	
Lighting	66.67%	0%	60%	60%	33.33%	0%	0 %	
DE	40%	0%	20%	33.33%	25%	0%	0 %	
Electricity	57.14%	66.67%	0%	27.27%	0%	77.78%	18.18 %	
EV	0%	0%	0%	66.67%	0%	66.67%	25 %	
M&C	62.50%	27.27%	33.33%	41.18%	50%	22.22%	66.67 %	

SMART2

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Figure C.8 — Smart2tool SRI Assessment

Bibliography

[1] Directive (EU) 2024/1275 of the European Parliament and of the Council of 24 April 2024 on the energy performance of buildings (recast)

[2] Commission Delegated Regulation (EU) 2020/2155 of 14 October 2020 supplementing Directive (EU) 2010/31/EU of the European Parliament and of the Council by establishing an optional common European Union scheme for rating the smart readiness of buildings

[3] Commission Implementing Regulation (EU) 2020/2156 of 14 October 2020 detailing the technical modalities for the effective implementation of an optional common Union scheme for rating the smart readiness of buildings

[4] EN ISO 52120-1, *Energy performance of buildings - Contribution of building automation, controls and building management - Part 1: General framework and procedures (ISO 52120-1:2021)*

[5] EN 16247-1, *Energy audits - Part 1: General requirements*

[6] EN 16247-2, *Energy audits - Part 2: Buildings*

[7] EN 16247-5, *Energy audits - Part 2: Competence of energy auditors*

[8] EN 17609, *Building automation and control systems. Control applications*

[9] EN 16946-1, *Energy Performance of Buildings - Inspection of Automation, Controls and Technical Building Management - Part 1: Module M10-11*

[10] CEN/TR 16946-2, *Energy Performance of Buildings - Inspection of Building Automation, Controls and Technical Building Management - Part 2: Accompanying TR prEN 16946-1:2015 – Modules M10-11*

[11] EN ISO 52000-1, *Energy performance of buildings - Overarching EPB assessment - Part 1: General framework and procedures*